SOIL SURVEY OF

Richland County, Montana

United States Department of Agriculture
Soil Conservation Service
In cooperation with
Montana Agricultural Experiment Station

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all who need the information, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1967 to 1972. Soil names and descriptions were approved in 1972. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1972. This survey was made cooperatively by the Soil Conservation Service and the Montana Agricultural Experiment Station. It is part of the technical assistance furnished to the Richland County Conservation District. Some funds were provided by the Board of County Commissioners, Richland County.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, woodlands, and wildlife areas; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Richland County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas maked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise it is outside the area and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to mapping units" can be used to find information. This guide lists all the soils of the area in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the range site in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green; those with a moderate limitation can be colored yellow; and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units, the range sites, and the windbreak groups.

Foresters and others can refer to the section "Windbreaks" where the soils of the county are discussed according to their suitability for trees and shrubs.

Wildlife managers and others can find information about soils and wildlife in the section "Wildlife."

Ranchers and others can find, under "Range," groupings of the soils according to their suitability for range and the names of many of the plants that grow on each range site.

Community planners and others can read about soil properties that affect the choice of sites for dwellings, industrial buildings, and recreation areas in the section, "County planning and recreation."

Engineers and builders can find, under "Engineering," tables that contain estimates of soil properties and information about soil features that affect engineering practices.

Scientists and others can read about the soils in the section, "Formation, morphology, and classification of the soils."

Newcomers in the area may be especially interested in the section, "General soil map," where broad patterns of soils are described. They may also be interested in the information about the survey area given in the section "General nature of the county."

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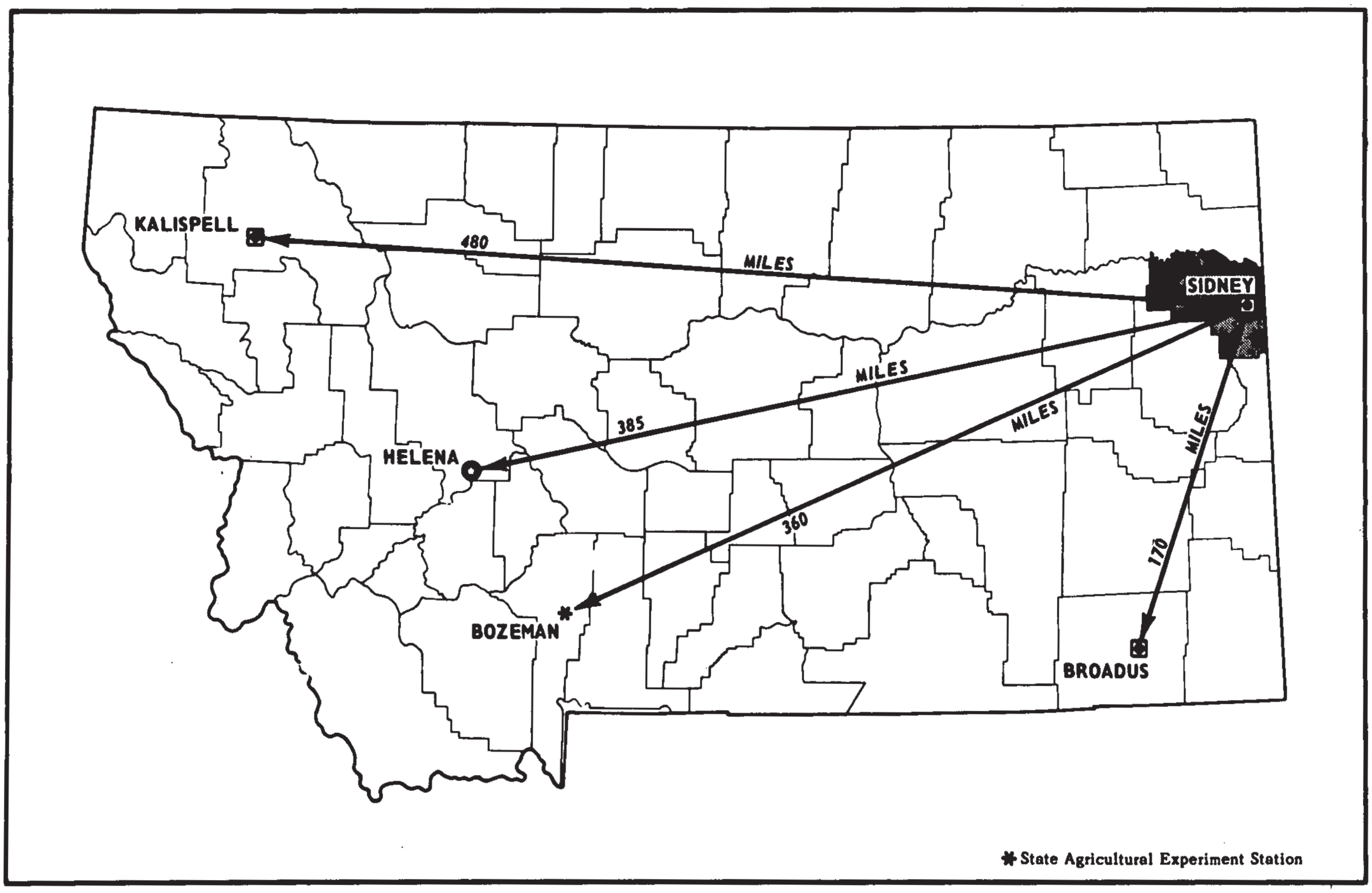

Location of Richland County in Montana.

SOIL SURVEY OF RICHLAND COUNTY, MONTANA

By Pedro Pescado, Jr. and Lester C. Brockmann, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service, in cooperation with Montana Agricultural Experiment Station

RICHLAND COUNTY lies in the eastern part of Montana. It has a land area of about 1,321,600 acres, or 2,065 square miles. Sidney, the county seat, is in the east-central part of the county.

About 40 percent of Richland County is cropland and pasture, about 54 percent is range, and about 6 percent is other land and water. The principal crops are wheat, barley, oats, hay, sugar beets, and corn for silage. Beef cattle and small grain production are the main enterprises.

Elevation ranges from 1,800 feet on the flood plains of the Yellowstone and Missouri Rivers in the northeast corner of the county to 2,900 feet on the divide between the drainageways of the Yellowstone and Redwater Rivers. The growing season is 110 to 130 days, and the average annual precipitation is about 13 inches. The mean annual air temperature is 41° to 43° F.

How this survey was made

Soil scientists made this survey to learn what kinds of soil are in Richland County, where they are located, and how they can be used. They went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of the slopes; the size and speed of streams; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey (*6*)[1].

Soils that have a similar profile make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or geographic feature near the place where a soil of that series was first observed and mapped. Williams and Vida, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil indicates a feature that affects management. For example, Shambo loam, 0 to 2 percent slopes, is one of several phases within the Shambo series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help to draw boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent because it is not practical to show on such a map all the small, scattered bits of soil of some kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series or of different phases within one series. Two such kinds of mapping units, the soil complex and the undifferentiated group, are shown on the soil map of Richland County.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils joined by a hyphen. Turner-Beaverton complex, 0 to 4 percent slopes, is an example.

An undifferentiated group is made up of two or more soils that could be mapped individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of

[1]Italic numbers in parentheses refer to Literature Cited, page 68.

an undifferentiated group consists of the names of the dominant soils, joined by "and." Cherry, Havrelon, and Trembles soils, occasionally flooded, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called miscellaneous areas and are given descriptive names, such as "Badland" and "Riverwash."

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kind of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is complete when the soils have been named, described, and mapped, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups, among whom are farmers, managers of woodland and rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General soil map

The general soil map at the back of this survey shows, in color, the soil associations in the survey area. A soil association is a landscape that has a distinctive pattern of soils in defined proportions. It typically consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in an association can occur in other associations but in different patterns.

A map showing soil associations is useful to people who want to have a general idea of the soils in a survey area, who want to compare different parts of that area, or who want to find suitable sites for a certain kind of land use. Such a map is a useful general guide for broad planning on a watershed, a wooded tract, or a wildlife area or for broad planning of recreation facilities, community developments, and engineering works. It is not a suitable map for detailed planning for management of a farm or field or for selecting a site for a road or building or other structure, because the soils within an association ordinarily vary in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in this survey area have been grouped into general kinds of landscapes for broad interpretative purposes. Each of the broad groups and the soil associations in it are described on the following pages.

Soils on stream terraces, flood plains, and alluvial fans

The three soil associations in this group consist of soils that dominantly have a fine sandy loam, loam, silt loam, clay loam, or clay surface layer. The soils are used mainly for irrigated crops and as range. Some areas have low-density stands of cottonwood trees.

This group makes up 10 percent of the county.

1. Trembles-Havrelon-Lohler association

Deep, nearly level and gently sloping, well drained and moderately well drained fine sandy loams, silt loams, silty clay loams, and clays underlain by stratified fine sandy loam to silty clay alluvium; on low terraces and flood plains

This association consists of nearly level, undulating, or gently sloping soils on narrow, low terraces and flood plains of the Missouri, Redwater, and Yellowstone Rivers and their tributaries.

This association makes up about 6 percent of the county. It is about 35 percent Trembles soils; 25 percent Havrelon soils; 25 percent Lohler soils; and 15 percent Banks, Benz, Ridgelawn, and Hoffmanville soils.

Trembles soils are mainly near streams, inside oxbow meanders, and on low ridges. The surface layer is grayish brown fine sandy loam, and the underlying material is light brownish gray fine sandy loam.

Havrelon and Lohler soils are mainly in broad, nearly level areas. Lohler soils are also in backwater areas and old streambeds. The surface layer of Havrelon soils is grayish brown silt loam or silty clay loam, and the underlying material is stratified light brownish gray fine sandy loam, silt loam, and loam. The surface layer of Lohler soils is grayish brown silty clay loam or clay, and the underlying material is grayish silty clay loam or silty clay.

Some areas of this association are irrigated. Trembles, Havrelon, Lohler, Banks, Ridgelawn, and Hoffmanville soils are used for cultivated crops. Benz soils are used mainly as range or irrigated pasture that is planted to salt- and alkali-tolerant grasses. Some areas are brush-covered range. Stands of cottonwood, willow, green ash, rosebush, chokecherry, and silver sagebrush afford excellent cover and browse for white-tailed deer and mule deer. There is abundant food and shelter for ring-necked pheasant and migrating flocks of waterfowl.

2. Cherry association

Deep, nearly level to sloping, well drained silty clay loams underlain by silt loam or silty clay loam alluvium; on alluvial fans and terraces

This association consists of nearly level to sloping soils in the valleys of most intermittent streams in the county. It is distributed throughout the county.

This association makes up about 3 percent of the county. It is about 70 percent Cherry soils and 30 percent Savage, Shambo, Trembles, and Havrelon soils.

The surface layer of Cherry soils is grayish brown silty clay loam. The subsoil and substratum are silt loam or silty clay loam.

Savage and Shambo soils are on nearly level to gently sloping fans and terraces. Trembles and Havrelon soils are on low terraces and flood plains.

This association is used mainly for dry and irrigated crops and for range. In some areas the early spring flow of small streams is diverted into dike systems to provide supplemental irrigation of hayland. Stands of brush and trees in some areas provide browse and cover for wildlife.

3. Marias-Vanda association

Deep, nearly level and gently sloping, well drained silty clays and clays underlain by silty clay and clay alluvium; on alluvial fans and terraces

This association consists of nearly level and gently sloping soils on alluvial fans and terraces. It is located in the northwest corner of the county.

This association makes up 1 percent of the county. It is about 40 percent Marias soils; 30 percent Vanda soils; and 30 percent Shambo, Cherry, and Benz soils.

Marias soils are mainly in the nearly level and convex areas. The surface layer is grayish brown silty clay, and the underlying material is grayish silty clay.

Vanda soils are mainly in swales and on concave, lower side slopes of fan ridges. The surface layer is light olive gray, and the underlying material is grayish, very strongly alkaline clay.

This association is used mainly for range. Some areas are used for dryfarmed grain and hay crops. Stands of sagebrush afford some browse and cover for wildlife.

Soils on benches, fans, and terraces on uplands

The two associations in this group consist of soils that formed in material that weathered from sedimentary beds and in old alluvium and sand and gravel deposits. These soils have a surface layer of loam, silt loam, or clay loam. They are mainly used for dryfarmed or irrigated crops. Some areas are used as range. The native vegetation is mainly western wheatgrass, thickspike wheatgrass, and shrubs and forbs. This group makes up 6 percent of the county.

4. Farnuf-Turner association

Deep, nearly level and gently sloping, well drained loams and clay loams underlain by clay loam alluvium or by sand and gravel; on high benches and terraces

This association consists of nearly level to gently sloping soils on broad, high benches and terraces on uplands. Areas are mainly north and west of the Yellowstone River. Most areas have slopes of less than 4 percent, but the slopes on the few low ridges and edges of benches are as much as 8 percent.

This association makes up about 4 percent of the county. It is about 50 percent Farnuf soils, 35 percent Turner soils, and 15 percent Beaverton and Savage soils.

Farnuf and Turner soils are on similar landscapes, but the Turner soils are moderately deep to sand and gravel. Farnuf soils have a dark grayish brown loam surface layer, a dark grayish brown and grayish brown clay loam subsoil, and a light olive brown clay loam substratum. Turner soils have a dark grayish brown clay loam surface layer. The subsoil is grayish brown clay loam, and grayish brown very gravelly loamy sand at a depth of 20 to 40 inches.

Most areas of this association are cultivated. Large acreages in the Yellowstone River Valley are irrigated. Most other areas are used for dryfarmed grain in rotation with a year of fallow. Antelope and white-tailed deer are the dominant wildlife. Numerous coveys of sharp-tailed grouse and gray partridge are hatched in fence rows and feed in the grain stubble.

5. Shambo association

Deep, nearly level and gently sloping, well drained loams underlain by loam and silt loam alluvium and sedimentary beds; on fans and terraces

This association consists of nearly level to gently sloping soils on fans and terraces on uplands. Most areas are south and east of the Yellowstone River, but one is located west of the river.

This association makes up about 2 percent of the county. It is about 85 percent Shambo soils and 15 percent Tally and Cherry soils.

Shambo soils have a dark grayish brown loam surface layer and subsoil. The substratum is light brownish gray loam or silt loam.

Most areas of this association are cultivated. Some areas east of the Yellowstone River are irrigated for sugar beets, corn, or alfalfa. Most other areas are used for dryfarmed grain or hay in rotation with a year of fallow. White-tailed deer, sharp-tailed grouse, gray partridge, and ring-necked pheasant are the dominant wildlife.

Soils on sedimentary plains

The four associations in this group consist of soils that formed mainly in material that weathered from silty and loamy sedimentary beds and soft sandstone and in alluvium and glacial till. These soils have a surface layer of fine sandy loam, loamy fine sand, loam, silt loam, and clay loam. They are used mainly for dryland farming and as range. The native vegetation is mainly western wheatgrass, thickspike wheatgrass, needleandthread, little bluestem, prairie sandreed, and shrubs and forbs.

This group makes up 26 percent of the county.

6. Dast-Blanchard association

Moderately deep and deep, undulating to rolling and hilly, well drained and excessively drained fine sandy loams and loamy fine sands underlain by soft sandstone; on uplands

This association consists of undulating to hilly soils on uplands south and east of Sidney. Low dunes, blowout spots, and outcrops of soft sandstone characterize the areas.

This association makes up about 1 percent of the county. It is about 60 percent Dast soils, 30 percent Blanchard soils, and 10 percent Lambert, Shambo, and Tally soils.

Dast soils are well drained and moderately deep and are underlain by soft sedimentary beds. They are mainly on the crests and sides of ridges. The surface layer is grayish brown fine sandy loam. It overlies light brownish gray and light yellowish brown fine sandy loam that weathered from weakly consolidated sandstone, which is at a depth of 20 to 40 inches. Blanchard soils are deep and excessively drained. They are mainly in dune-shaped areas and in other areas where sand has accumulated. The surface layer is grayish brown, and the underlying material is light brownish gray. Texture is loamy fine sand throughout. Soft sandstone is at a depth of 54 to 60 inches or more.

This association is used for range. Most areas are in grasses intermixed with shrubs. White-tailed deer and sharp-tailed grouse are the dominant wildlife.

7. Shambo-Lambert association

Deep, nearly level to moderately steep, well drained loams and silt loams underlain by loam and silt loam alluvium and sedimentary beds; on uplands

This association consists of smooth, nearly level to moderately steep soils on low rounded ridges and in broad swales. Areas are large and are scattered throughout the southern half of the county. Drainageways in swales are shallow and meandering.

This association makes up about 11 percent of the county. It is about 65 percent Shambo soils, 25 percent Lambert soils, and 10 percent Cherry, Farnuf, and Vida soils.

Shambo soils are mainly in broad swales. The surface layer and subsoil are dark grayish brown loam, and the substratum is light brownish gray loam or silt loam. Lambert soils are mainly on low, rounded ridges. They have a brown surface layer and pale brown underlying material. They are silt loam throughout.

Most areas of this association are used for dryfarmed grain in rotation with a year of fallow. The areas that are used as range have a good grass cover. Antelope, sharp-tailed grouse, and gray partridge are the dominant wildlife.

8. Lambert association

Deep, nearly level to moderately steep, well drained silt loams underlain by silt loam sedimentary beds; on uplands

This association consists of smooth, nearly level to moderately steep soils on low, rounded ridges and in broad, smooth swales. Areas are scattered throughout the southern half of the county, mainly on parts of ridges that separate major drainageways. Drainageways in the swales are shallow and meandering.

This association makes up about 8 percent of the county. It is about 70 percent Lambert soils and 30 percent Cherry, Dast, Dimyaw, and Shambo soils.

Lambert soils have a brown silt loam surface layer. The underlying material is pale brown silt loam.

Some areas of this association are used for dryfarmed grain in rotation with a year of fallow. Most areas are in grass and are used as range; some small areas of brush are at the bottom of swales. Antelope and sharp-tailed grouse are the dominant wildlife.

9. Shambo-Vida association

Deep, undulating to rolling and hilly, well drained loams and clay loams underlain by loam or clay loam alluvium or clay loam glacial till; on uplands

This association consists of smooth, undulating to rolling and hilly soils. Areas are scattered throughout the central uplands at the contact between the sedimentary plains and the glaciated plains. The soils are on low, rounded ridges and in broad swales. Drainageways in the swales are shallow and meandering.

This association makes up about 6 percent of the county. It is about 45 percent Shambo soils, 35 percent Vida soils, and 20 percent Zahill, Lambert, and Cherry soils.

Shambo soils are mainly in broad swales. The surface layer and subsoil are dark grayish brown loam, and the substratum is light brownish gray loam or silt loam. Vida soils are mainly on the low, rounded ridges. The surface layer and subsoil are brown clay loam, and the substratum is very pale brown gravelly clay loam glacial till.

Most areas are used for dryfarmed grain in rotation with a year of fallow. Some areas are used as range. Antelope, sharp-tailed grouse, and gray partridge are the dominant wildlife.

Soils on dissected sedimentary plains

The three associations in this group consist of soils that formed in material that weathered from loamy, silty, and clayey sedimentary beds. These soils have a surface layer of silt loam, silty clay loam, gravelly sandy loam, gravelly loamy sand, and gravelly loam. They are used mainly as range. There are outcrops of the underlying sedimentary beds on the side slopes of coulees. The native vegetation is mainly western wheatgrass, thickspike wheatgrass, little bluestem, needleandthread, and forbs and shrubs.

This group makes up 14 percent of the county.

10. Lambert-Dimyaw association

Deep, steep and very steep, well drained silt loams and silty clay loams underlain by silt loam or silty clay loam and silty clay sedimentary beds; on uplands

This association consists of steep to very steep soils on uplands dissected by many steep-sided coulees. Areas are large and widely distributed. Numerous outcrops of the soft sedimentary beds that underlie this association appear on ridgetops and steep sides of coulees.

This association makes up about 10 percent of the county. It is about 65 percent Lambert soils; 20 percent Dimyaw soils; and 15 percent areas of outcrops of the soft sedimentary beds and areas of Ringling, Cherry, Shambo, and Dast soils.

Lambert and Dimyaw soils are on similar landscapes but formed in different textured sedimentary beds. Lambert soils formed in silt loam sedimentary beds. Their surface layer is brown silt loam, and the underlying material is pale brown to light yellowish brown silt loam. Dimyaw soils formed in clayey sedimentary beds. The surface layer is light brownish gray silty clay loam, and the underlying material is light gray silty clay loam or silty clay.

This association is used for range. Grass cover and brushy bottoms of coulees provide food and cover for white-tailed deer, mule deer, and sharp-tailed grouse.

11. Tinsley-Lambert association

Deep, steep and very steep, well drained and excessively drained gravelly sandy loams, gravelly loamy sands, and gravelly loams underlain by gravelly sand or silt loam sedimentary beds; on uplands

This association consists of steep and very steep, gravelly soils at the edge of benches and terraces, mainly in long, narrow areas along the western edge of the Yellowstone River Valley. It makes up the breaks between the nearly level, high benches and the alluvial fans and terraces in major stream valleys.

This association makes up about 3 percent of the county. It is about 55 percent Tinsley soils; 30 percent Lambert soils; and 15 percent Lihen, Tally, and Zahill soils and outcrops of sedimentary beds.

Tinsley soils are excessively drained and are on the rounded edges of benches and terraces. The surface layer is grayish brown gravelly sandy loam and is underlain by gravelly sand and very gravelly sand.

Lambert soils are on the very steep sides of coulees. The surface layer is mainly brown or light brownish gray gravelly loam and is underlain by silt loam. Small areas of sedimentary beds outcrop on the sides of coulees.

This association is used for range. Brushy coulee bottoms provide food and cover for deer and sharp-tailed grouse. Springs in many of the coulees furnish water for domestic livestock and wildlife.

12. Badland association

Steep and very steep, severely eroded land consisting mainly of outcroppings of silty, sandy, and clayey sedimentary beds; on broken uplands

This association consists of very steep walls of deeply entrenched coulees that expose the multicolored, soft, sandy, silty, and clayey sedimentary bed underlying the county. Areas are long and irregular in shape and are in the northwestern part of the county. Narrow ridgetops that have undulating to rolling surfaces support moderate stands of grasses, and in some places, sparse stands of scrubby juniper and pine trees. In the bottoms of some coulees there are nearly level to sloping alluvial fans and terraces that support sparse to moderate stands of grass and shrubs.

This association makes up about 1 percent of the county. It is about 75 percent Badland and 25 percent Benz, Trembles, Lambert, Dimyaw, Dast, and Blanchard soils, each about equal in extent.

Badland consists of the very steep sidewalls, long ridges, and isolated buttes formed by the cutting of deep coulees into the soft brownish sandy beds; buff silty beds, and grayish clayey beds. Many thin seams of coal and strata of reddish clayey shale are also exposed. Some areas of the association have exposed sandy beds that have hardened and formed ledges of sandstone.

This association is used for wildlife, recreation, and watershed. Accessible ridgetops and bottoms of coulees that contain Benz, Trembles, Lambert, Dimyaw, Dast, and Blanchard soils are used as range and are grazed by cattle. On the steep Badlands there are small patches of grass, forbs, and brush in areas that are nearly inaccessible to cattle. Wildlife in the area is white-tailed deer, mule deer, and sharp-tailed grouse.

Soils on glaciated plains

The three associations in this group consist of soils that formed in clay loam glacial till. These soils have a surface layer of loam, clay loam, and silt loam. They are used mainly for dryland farming, and the steeper areas are used as range. The native vegetation is mainly western wheatgrass, thickspike wheatgrass, little bluestem, and shrubs and forbs.

This group makes up 44 percent of the county.

13. Vida-Williams association

Deep, nearly level to rolling and hilly, well drained loams and clay loams underlain by clay loam glacial till; on uplands

This association consists of broad areas of nearly level and gently undulating to rolling and hilly soils that are underlain by clay loam glacial till. Areas are mainly north and west of Yellowstone River on uplands. The glacial till is dominantly granitic material—mainly gravel and a few cobblestones and boulders. Only small areas of the association contain enough of these rocks to limit cultivation.

This association makes up about 20 percent of the county. It is about 55 percent Vida soils, 30 percent Williams soils, and 15 percent Zahill, Bowbells, and Dooley soils.

Vida soils are mainly on the rolling and hilly part of the association. The surface layer and subsoil are brown clay loam. The substratum is very pale brown gravelly clay loam glacial till. On grasslands the surface layer is mainly loam.

Williams soils are mainly in small, nearly level areas and in swales. The surface layer is dark grayish brown loam. The subsoil is dark grayish brown to light brownish gray clay loam, and the substratum is light brownish gray clay loam till.

Most areas of this association are used for dryfarmed small grain in rotation with a year of fallow. The areas of this association that are used as range are steeper and generally are part of large ranches. Range vegetation consists of sod-forming grasses and bunch grass.

Antelope, sharp-tailed grouse, and gray partridge are the common wildlife.

14. Vida-Zahill association

Deep, rolling and hilly to steep, well drained loams and clay loams underlain by clay loam glacial till; on uplands

This association consists of rolling and hilly to steep soils on glaciated uplands. Areas are mainly in the northern part of the Missouri River drainage system. The soils contain varying amounts of gravel. Scattered granitic cobblestones, stones, and boulders on the surface are characteristic of the landscape.

This association makes up about 15 percent of the county. It is about 45 percent Vida soils, 40 percent Zahill soils, and 15 percent Williams and Shambo soils.

Vida soils are on the lower side slopes and in swales. The surface layer is brown loam or clay loam, and the subsoil is brown clay loam. The substratum is very pale brown clay loam glacial till.

Zahill soils are on ridge crests and upper side slopes. The surface layer is thin dark grayish brown loam and is underlain by grayish brown and light brownish gray clay loam glacial till.

Most areas of this association are used for dry-farmed grain. The remainder is used as range.

Brush and trees in bottoms of coulees provide browse and cover for mule deer. This association provides food and shelter for sharp-tailed grouse and gray partridge.

15. Zahill-Lambert association

Deep, moderately steep to very steep, well drained loams underlain by clay loam glacial till and silt loams underlain by silt loam sedimentary beds; on uplands

This association consists of steep to very steep soils on narrow ridges and intervening valleys at the edges of glacial uplands. Areas are scattered throughout the county. Ridges are capped by a mantle of glacial till that has granitic rocks—mainly gravel, but some boulders—on the surface. Lower side slopes of ridges and bottoms of the narrow valleys are underlain by soft, silty sedimentary beds.

This association makes up about 9 percent of the county. It is about 40 percent Zahill soils; 35 percent Lambert soils; 15 percent Shambo and Vida soils; and 10 percent Tinsley soils, which occur mainly in areas within the Yellowstone River drainageway.

Zahill soils are on the ridge crests and upper side slopes. The surface layer is thin dark grayish brown loam and is underlain by grayish brown and light brownish gray clay loam glacial till.

Lambert soils are on the lower side slopes of ridges and in swales. They have a brown silt loam surface layer, and the underlying material is pale brown to light yellowish brown silt loam.

Most areas of this association are used as range. Trees and brush in bottoms of coulees provide browse and cover for white-tailed deer and mule deer. Coveys of sharp-tailed grouse and gray partridge are common on this association.

Descriptions of the soils

This section describes each soil series in detail and then, briefly, each mapping unit in that series. Unless stated otherwise, what is stated about the soil series is true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface down to rock or other underlying material. The profile of each series is described twice. The first description is brief and in terms familiar to a layman. The second is more detailed and is for those who need to make thorough and precise studies of soils. The profile described is representative of mapping units in a series. If the profile of a given mapping unit is different from the one described for the series, the differences are apparent in the name of the mapping unit, or they are stated in describing the mapping unit. Color terms are for dry soil unless otherwise stated.

As mentioned in the section "How this survey was made," not all mapping units are members of a soil series. Badland and Riverwash, for example, do not belong to a soil series. Nevertheless, they are listed in alphabetic order with the soil series.

Preceding the name of each mapping unit is a symbol that identifies it on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit or subclass and range site in which the mapping unit has been placed. The page where each capability unit and range site is described is listed in the "Guide to mapping units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual.

Adger series

The Adger series consists of deep, well drained, nearly level to sloping soils on upland fans and terraces. These soils formed in alkaline alluvium. The native vegetation is mainly western wheatgrass and thickspike wheatgrass. It includes a few forbs and shrubs.

In a representative profile the surface layer is dark grayish brown silt loam 2 inches thick, and the subsurface layer is grayish brown silty clay loam 2 inches thick. The subsoil is dark grayish brown silty clay 11 inches thick, and the substratum is grayish brown silty clay.

Permeability is slow, and the available water capacity is high.

Representative profile of Adger silty clay loam, 0 to 8 percent slopes, in grass 300 feet east and 25 feet north of the southwest corner of sec. 27, T. 26 N., R. 51 E.

A1—0 to 2 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable, slightly sticky and nonplastic; many roots; mildly alkaline; clear wavy boundary.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Mapping unit symbol	Mapping unit name	Area	Extent
		Acres	*Percent*
AdC	Adger silty clay loam, 0 to 8 percent slopes	2,107	0.2
Ba	Badland	19,485	1.5
BkB	Banks loamy fine sand, 0 to 4 percent slopes	11,002	.8
BmB	Benz clay loam, 0 to 4 percent slopes	4,569	.3
BnC	Benz-Trembles complex, 0 to 8 percent slopes	2,364	.2
BoB	Bowbells silt loam, 0 to 4 percent slopes	3,404	.2
CeA	Cherry silty clay loam, 0 to 2 percent slopes	25,650	1.9
CeB	Cherry silty clay loam, 2 to 4 percent slopes	19,413	1.5
CeC	Cherry silty clay loam, 4 to 8 percent slopes	2,301	.2
Ch	Cherry, Havrelon, and Trembles soils, occasionally flooded	25,902	2.0
DbD	Dast-Blanchard complex, 8 to 25 percent slopes	1,323	.1
DmD	Dimyaw silty clay loam, 8 to 25 percent slopes	3,303	.3
DoB	Dooley fine sandy loam, 2 to 6 percent slopes	1,387	.1
FaA	Farnuf loam, 0 to 2 percent slopes	9,143	.7
FaB	Farnuf loam, 2 to 4 percent slopes	1,552	.1
HaA	Havrelon silt loam, 0 to 1 percent slopes	21,437	1.6
HaB	Havrelon silt loam, 1 to 4	888	(1)
Hb	Havrelon silty clay loam	8,952	.6
Ho	Hoffmanville silty clay	2,339	.2
LaE	Lambert gravelly loam, 15 to 40 percent slopes	6,138	.5
LbC	Lambert silt loam, 2 to 8 percent slopes	16,480	1.3
LbD	Lambert silt loam, 8 to 15 percent slopes	82,112	6.2
Lc	Lambert-Badland complex	80,778	6.2
LeD	Lambert-Blanchard complex, 8 to 25 percent slopes	9,118	.7
LfF	Lambert-Dimyaw complex, 15 to 65 percent slopes	109,197	8.3
LhF	Lambert-Ringling complex, 15 to 65 percent slopes	13,893	1.1
LmD	Lihen loamy fine sand, 4 to 15 percent slopes	5,438	.4
Lo	Lohler silty clay loam	14,833	1.1
Lp	Lohler clay	1,952	.2
Lw	Lohler clay, wet	812	(1)
Ma	Marias silty clay	1,456	.1
Rd	Ridgelawn loam	6,887	.5
Rw	Riverwash	2,341	.2
SaA	Savage silty clay loam, 0 to 2 percent slopes	9,350	.7
SaB	Savage silty clay loam, 2 to 4 percent slopes	780	(1)
ShA	Shambo loam, 0 to 2 percent slopes	26,837	2.0
ShB	Shambo loam, 2 to 4 percent slopes	34,611	2.6
ShC	Shambo loam, 4 to 8 percent slopes	10,178	.8
SmC	Shambo-Lambert complex, 4 to 8 percent slopes	96,771	7.3
SmD	Shambo-Lambert complex, 8 to 15 percent slopes	14,145	1.1
St	Strip mines, reclaimed	500	(1)
TaA	Tally fine sandy loam, 0 to 2 percent slopes	1,521	.1
TaB	Tally fine sandy loam, 2 to 4 percent slopes	1,548	.1
TaC	Tally fine sandy loam, 4 to 12 percent slopes	5,931	.5
TeF	Tinsley soils, 15 to 65 percent slopes	24,503	1.9
Tm	Trembles fine sandy loam	7,681	.6
ToB	Turner-Beaverton complex, 0 to 4 percent slopes	14,926	1.1
Tw	Typic Haplaquents	18,727	1.4
Va	Vanda clay	2,404	.2
VdB	Vida clay loam, 1 to 4 percent slopes	47,813	3.6
VdC	Vida clay loam, 4 to 8 percent slopes	154,027	11.7
VhC	Vida-Zahill complex, 4 to 8 percent slopes	47,428	3.6
VhD	Vida-Zahill complex, 8 to 15		
VhD	Vida-Zahill complex, 8 to 15 percent slopes	55,332	4.2
WmB	Williams loam, 0 to 4 percent slopes	42,223	3.2
ZaF	Zahill loam, 15 to 65 percent slopes	93,349	7.1
ZbF	Zahill-Lambert complex, 15 to 65 percent slopes	93,059	7.0
	Total	1,321,600	100.0

[1] Less than 0.1 percent.

A2—2 to 4 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; mildly alkaline; abrupt smooth boundary.

B2t—4 to 15 inches; dark grayish brown (10YR 4/2) silty clay, very dark brown (10YR 2/2) moist; strong medium columnar structure; very hard, firm, sticky and plastic; common fine roots and pores; continuous clay films on vertical ped faces; few seams of lime and gypsum; strongly alkaline; gradual wavy boundary.

Ccacs—15 to 60 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure; very hard, firm, sticky and plastic; few fine roots; common seams of lime and gypsum; strongly effervescent; very strongly alkaline.

The A horizon ranges from 2 to 5 inches in thickness. Texture is loam, silt loam, or silty clay loam. Thin strata of gravelly clay occur at a depth of 40 inches or more in some profiles.

AdC—Adger silty clay loam, 0 to 8 percent slopes. This nearly level to sloping soil is on glaciated uplands. Included in mapping are small areas of Williams, Vida, and Zahill soils and areas where the surface layer is silt loam or clay loam.

Runoff is slow to medium, and the hazard of erosion is high. This soil is used mainly as range. A few small areas are used for dryfarmed crops. Capability subclass VIe, dryland; Dense Clay range site, 10- to 14-inch precipitation zone.

Badland

Ba—Badland. This mapping unit consists mainly of very steep, nearly barren land. The landscape is characterized by nearly vertical escarpments, narrow ridges, isolated buttes, and deeply entrenched coulees. These features were formed by active geologic erosion

of soft, multicolored, loamy sand, sandy loam, silt loam, clay loam, and silty clay sedimentary beds. Slopes range from 15 percent to nearly vertical escarpments. This unit is about 75 percent barren to nearly barren sedimentary beds.

Included in mapping are areas of Benz and Trembles soils on bottoms of coulees and Blanchard, Dast, Dimyaw, and Lambert soils on ridges and buttes.

Runoff is very rapid, and the hazard of erosion is very high. Most areas of Badland are used for wildlife habitat and watershed. The included soils support grasses and forbs and shrubs and are used as range where accessible. Grazing management is difficult on these soils because of limited acreage, remoteness of the areas from one another, and inaccessibility. Extreme care is needed to prevent overgrazing and subsequent erosion that could destroy the limited range resources. For information about the vegetation on these included soils, refer to the range site that includes the soil in question. Capability subclass VIIIe.

Banks series

The Banks series consists of deep, somewhat excessively drained, nearly level and gently sloping soils on low terraces and flood plains. These soils formed in recent alluvium along the major streams. The native vegetation is mainly prairie sandreed, little bluestem, and sand bluestem. It includes a few forbs and shrubs.

In a representative profile the surface layer is grayish brown loamy fine sand 8 inches thick. The underlying material, to a depth of 60 inches or more, is light brownish gray stratified fine sand, fine sandy loam, and loamy fine sand.

The available water capacity is moderate, and permeability is rapid.

Representative profile of Banks loamy fine sand, 0 to 4 percent slopes, in a cultivated field, 800 feet east and 700 feet north of center of sec. 29, T. 24 N., R. 60 E.

Ap—0 to 8 inches; grayish brown (2.5Y 5/2) loamy fine sand, dark grayish brown (2.5Y 4/2) moist; weak fine granular structure; soft, very friable; common fine roots; mildly alkaline; abrupt smooth boundary.

C—8 to 60 inches; light brownish gray (2.5Y 6/2) stratified fine sand, fine sandy loam, and loamy fine sand, dark grayish brown (2.5Y 4/2) moist; single grain; loose, dry and moist; few fine roots; strongly effervescent; moderately alkaline.

The A horizon ranges from grayish brown to light brownish gray. The C horizon is dominantly loamy fine sand, but thin strata of finer and coarser textured material are common in most pedons.

BkB—Banks loamy fine sand, 0 to 4 percent slopes. This nearly level and gently sloping soil is on low terraces and flood plains along major streams in the county.

Included in mapping are areas where the surface layer is fine sandy loam or fine sand. These soils are similar to Banks loamy fine sand, except the surface layer is 6 to 12 inches thick. Use and management of the soils are also similar. Also included are small areas of Havrelon and Trembles soils and Riverwash.

Runoff is very slow, and the hazard of soil blowing is very high. Some areas are flooded during unseasonably warm winters when ice jams form on the major streams in the county. This soil is used as range and for irrigated crops. Capability units IVe-2, dryland, and IVe-1, irrigated; Sands range site, 10- to 14-inch precipitation zone.

Beaverton series

The Beaverton series consists of well drained, nearly level and gently sloping soils on terraces and uplands. These soils formed in loam and clay loam alluvium underlain by sand and gravel at a depth of 10 to 20 inches. The native vegetation is mainly needleandthread, western wheatgrass, thickspike wheatgrass, and little bluestem. It includes a few forbs.

In a representative profile the surface layer is dark grayish brown loam 5 inches thick, and the subsoil is brown clay loam and brown gravelly loam 8 inches thick. The substratum, to a depth of 18 inches, is light brownish gray gravelly sandy loam. Below that it is gravelly sand to a depth of 60 inches or more.

The available water capacity is low. Permeability is moderate in the upper part of the profile and very rapid in the underlying sand and gravel.

Representative profile of Beaverton loam, in an area of Turner-Beaverton complex, 0 to 4 percent slopes, in grassland, 600 feet east and 150 feet south of the west quarter corner of sec. 13, T. 23 N., R. 59 E.

A1—0 to 5 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; abundant roots; 10 percent pebbles; neutral; clear wavy boundary.

B2t—5 to 10 inches; brown (10YR 5/3) clay loam, dark brown (10 3/3) moist; moderate medium prismatic structure that parts to moderate medium blocky; hard, friable, sticky and plastic; common roots; continuous clay films on vertical ped faces; 10 percent pebbles; neutral; clear wavy boundary.

B3ca—10 to 13 inches; brown (10YR 5/3) gravelly loam, dark brown (10YR 4/3) moist; weak medium prismatic structure that parts to weak fine blocky; hard, friable, slightly sticky and slightly plastic; few to common fine roots; 40 percent pebbles; strongly effervescent; soft nodules of lime on pebbles; moderately alkaline; gradual wavy boundary.

C1ca—13 to 18 inches; light brownish gray (2.5Y 6/2) gravelly sandy loam, grayish brown (2.5Y 5/2) moist; weak coarse prismatic structure; hard, very friable, nonsticky and nonplastic; few roots; 40 percent pebbles; violently effervescent; common threads and soft nodules of lime and lime casts on pebbles; moderately alkaline; clear wavy boundary.

IIC2ca—18 to 60 inches; light brownish gray (2.5Y 6/2) gravelly sand, dark grayish brown (2.5Y 4/2) moist; single grain; loose; 40 percent pebbles; violently effervescent; lime casts on pebbles; moderately alkaline.

The A horizon is dark grayish brown to brown. The Ap horizon is loam or clay loam. The B horizon is dark grayish brown to brown. The IIC horizon begins at a depth of 10 to 20 inches and is sandy or loamy sand with 35 to 70 percent pebbles.

Beaverton soils are mapped only in a complex with Turner soils.

Benz series

The Benz series consists of deep, well-drained, nearly level to sloping soils on fans and low terraces. These

soils formed in stratified alkaline alluvium. The native vegetation is mainly western wheatgrass, short grasses, saltbrush, and silver sagebrush. It includes a few forbs and shrubs.

In a representative profile the surface layer is grayish brown clay loam 8 inches thick. The underlying material, to a depth of 60 inches or more, is light brownish gray stratified clay loam, loam and fine sandy loam. The surface layer is strongly alkaline, and the underlying material is very strongly alkaline.

Permeability is slow, and the available water capacity is high.

Representative profile of Benz clay loam, 0 to 4 percent slopes, in a cultivated field, 100 feet west and 400 feet south of the center of sec. 10, T. 20 N., R. 58 E.

Ap—0 to 8 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; the upper ¼ inch to 1 inch is crusted; weak fine granular structure below crusted surface; hard, friable, sticky and plastic; few fine roots; few fine gypsum crystals; strongly alkaline; abrupt smooth boundary.

C1—8 to 22 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium platy structure; hard, friable, sticky and plastic; few fine roots and pores; few fine gypsum crystals; very strongly alkaline; clear wavy boundary.

C2—22 to 60 inches; light brownish gray (2.5Y 6/2) stratified fine sandy loam and loam, grayish brown (2.5Y 5/2) moist; massive; hard, very friable, slightly sticky and slightly plastic; very strongly alkaline.

The A horizon is light brownish gray to grayish brown. Some pedons have thin strata of silty clay loam and fine sand.

BmB—Benz clay loam, 0 to 4 percent slopes. This nearly level and gently sloping soil occurs on alluvial fans and stream terraces. It has the profile described as representative of the series. In cultivated areas or in areas of range trampled by livestock, a thin crust forms on the surface.

Included in mapping are small areas of Havrelon, Trembles, and Vanda soils. Also included are small areas of soils that have a fine sandy loam surface layer.

Runoff is slow to medium, and the hazard of erosion is high. Local areas are flooded during unseasonably warm winters when there are ice jams on the major streams of the county. Most areas are used as range. A few areas adjacent to irrigated soils are used for irrigated crops. Capability subclass VIe, dryland; Saline Upland range site, 10- to 14-inch precipitation zone.

BnC—Benz-Trembles complex, 0 to 8 percent slopes. These nearly level to sloping soils are on dissected terraces and fans, mainly in narrow, deep-cut coulees that drain steep, broken uplands and badlands. The Benz soil differs from the one described as representative of the series in having a surface layer 4 to 6 inches thick that does not crust on drying.

The remaining 20 percent of the complex is mainly Havrelon, Lohler, Banks, and Vanda soils. Some areas include eroded ridges and knobs of exposed sedimentary beds and sharply meandering, deep-cut flood channels that are subject to stream overflow during spring and summer.

Runoff is slow to medium, and the hazard of erosion is very high. These soils are used as range. Capability subclass VIe, dryland; Benz soil in Saline Upland range site, 10- to 14-inch precipitation zone, and Trembles soil in Sandy range site, 10- to 14-inch precipitation zone.

Blanchard series

The Blanchard series consists of deep, excessively drained, rolling to moderately steep soils on hills and side slopes of sedimentary plains. These soils formed in materials that weathered from weakly consolidated sandstone and were reworked by wind and water. The native vegetation is mainly prairie sandreed, little bluestem, and sand bluestem. It includes a few forbs and shrubs.

In a representative profile the surface layer is grayish brown loamy fine sand 6 inches thick. The underlying material is light brownish gray loamy fine sand to a depth of 60 inches or more.

Permeability is rapid, and the available water capacity is low.

Representative profile of Blanchard loamy fine sand, in an area of Lambert-Blanchard complex, 8 to 25 percent slopes, in grassland, 800 feet east and 300 feet north of the southwest corner of sec. 35, T. 23 N., R. 53 E.

A1—0 to 6 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; many fine roots; neutral; clear wavy boundary.

C—6 to 60 inches; light brownish gray (10YR 6/2) loamy fine sand, grayish brown (10YR 5/2) moist; very weak very coarse prismatic structure in upper 10 inches, single grain below; loose, dry and moist; common fine and few large roots; mildlv alkaline.

The A1 horizon is grayish brown to brown. The C horizon is loamy fine sand or fine sand. Structure of the upper 4 to 15 inches of the C horizon ranges from weak to very weak and coarse to very coarse prismatic. Depth to unconsolidated sandstone is 54 to more than 60 inches.

Blanchard soils are mapped only in complex with Dast and Lambert soils.

Bowbells series

The Bowbells series consists of deep, moderately well drained, nearly level and gently sloping soils in potholes and swales on glaciated uplands. These soils formed in calcareous clay loam glacial till. The native vegetation is mainly western wheatgrass and thickspike wheatgrass. It includes a few forbs and shrubs.

In a representative profile the surface layer is dark brown silt loam 7 inches thick. The subsoil is dark grayish brown and grayish brown clay loam 17 inches thick. The lower part is calcareous. The substratum is light brownish gray clay loam to a depth of 60 inches or more.

Permeability is moderate in the upper 29 inches and moderately slow in the underlying firm till. The available water capacity is high.

Representative profile of Bowbells silt loam, 0 to 4 percent slopes, in a cultivated field, 1,250 feet south and 825 feet east of the northwest corner of sec. 31, T. 21 N., R. 57 E.

Ap—0 to 7 inches; dark brown (10YR 4/3) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; mildly alkaline; abrupt smooth boundary.

B2t—7 to 21 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure; hard, friable, sticky and plastic; common fine roots and pores; common thin clay films on vertical ped faces; mildly alkaline; gradual wavy boundary.

B3ca—21 to 24 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure; hard, friable, sticky and plastic; common fine roots; calcareous; common thin patchy clay films on vertical ped faces; moderately alkaline; gradual wavy boundary.

C1ca—24 to 29 inches; grayish brown (10YR 5/2) clay loam, dark brown (10YR 4/3) moist; weak medium prismatic structure that parts to moderate medium blocky; hard, friable, slightly sticky and slightly plastic; few fine roots; few fine pores; violently effervescent; common threads and soft nodules of lime; moderately alkaline; gradual wavy boundary.

C2—29 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure that parts to moderate fine angular blocky; hard, firm, sticky and plastic; strongly effervescent; few fine threads and soft nodules of lime; strongly alkaline.

The depth to lime ranges from 20 to 40 inches. The depth to the moderately slowly permeable firm till is 24 to 40 inches.

BoB—Bowbells silt loam, 0 to 4 percent slopes. This nearly level and gently sloping soil is in large potholes and long wide swales on glaciated uplands. Included in mapping are small areas of Vida and Williams soils.

Runoff is very slow to slow, and the hazard of erosion is slight. This soil is used for dryfarmed crops and as range. Capability unit IIIe-2, dryland; Silty range site, 10- to 14-inch precipitation zone.

Cherry series

The Cherry series consists of deep, well drained nearly level to sloping soils on alluvial fans and terraces along streams throughout the county. These soils formed in alluvium. The native vegetation is mainly western wheatgrass and thickspike wheatgrass and includes a few forbs and shrubs.

In a representative profile the surface layer is grayish brown silty clay loam 11 inches thick. The subsoil is light yellowish brown silty clay loam 10 inches thick. The substratum, to a depth of 60 inches or more, is light yellowish brown silty clay loam with thin strata of silty clay.

Permeability is moderate in the upper part of the profile and moderately slow in the substratum. Available water capacity is high.

Representative profile of Cherry silty clay loam, 0 to 2 percent slopes, in a cultivated field, 900 feet east and 100 feet north of the west quarter corner of sec. 2, T. 23 N., R. 59 E.

Ap—0 to 11 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate fine granular structure; slightly hard, friable, sticky and plastic; common fine roots; slightly effervescent; moderately alkaline; abrupt smooth boundary.

B2—11 to 21 inches; light yellowish brown (2.5Y 6/3) silty clay loam, light olive brown (2.5Y 5/4) moist; moderate medium prismatic structure; hard, friable, sticky and plastic; common fine roots and pores; slightly effervescent; moderately alkaline; gradual wavy boundary.

C—21 to 60 inches; light yellowish brown (2.5Y 6/3) silty clay loam with thin strata of silty clay, light olive brown (2.5Y 5/4) moist; weak coarse prismatic structure; hard, friable, sticky and plastic; common fine roots and pores; strongly effervescent; moderately alkaline.

The A horizon is light brownish gray to grayish brown. The B horizon is light yellowish brown to grayish brown silt loam or silty clay loam. The C horizon is silt loam or silty clay loam.

CeA—Cherry silty clay loam, 0 to 2 percent slopes. This nearly level soil is on fans and terraces along drainageways and streams. It has the profile described as representative of the series.

Included in mapping are small areas of Havrelon, Lohler, Marias, and Savage soils. Also included are small areas of soils that have a silt loam surface layer.

Runoff is slow, and the hazard of erosion is none to slight. This soil is used for dryfarmed and irrigated crops and as range. Capability units IIIc-2, dryland, and IIc-1, irrigated; Silty range site, 10- to 14-inch precipitation zone.

CeB—Cherry silty clay loam, 2 to 4 percent slopes. This gently sloping soil is on fans and terraces along drainageways and streams.

Included in mapping are small areas of Savage, Marias, and Shambo soils. Also included are small areas of soils that have a silt loam surface layer.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. This soil is used for dryfarmed and irrigated crops and as range. Capability units IIIe-2, dryland, and IIe-1, irrigated; Silty range site, 10- to 14-inch precipitation zone.

CeC—Cherry silty clay loam, 4 to 8 perecnt slopes. This sloping soil is on alluvial fans along drainageways near streams.

Included in mapping are small areas of Lambert and Shambo soils. Also included are small areas of soils that have a silt loam surface layer.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for dryfarmed crops and as range. A few small areas are used for irrigated crops. Capability units IIIe-6, dryland, and IIIe-1, irrigated; Silty range site, 10- to 14-inch precipitation zone.

Ch—Cherry, Havrelon, and Trembles soils, occasionally flooded. This is an undifferentiated unit consisting of Cherry silty clay loam, Havrelon silt loam, and Trembles fine sandy loam. These are nearly level and gently sloping soils on low terraces and flood plains in narrow valleys of intermittent streams and on islands in the Yellowstone and Missouri Rivers. These soils are similar in use and management. The areas are subject to periodic, damaging stream overflow. Slopes are commonly less than 4 percent but some short, steep terrace breaks and meandering stream channels are included.

Cherry, Havrelon, and Trembles soils make up about 60 to 70 percent of the acreage. Any one of these soils may dominate a particular area.

Included in mapping are areas of Banks, Shambo, and Farnuf soils. In a few places the water table rises to within 30 inches of the surface.

Runoff is slow, and the hazard of erosion is high because of stream overflow. These soils are used as range. Capability subclass VIw, dryland; Overflow range site, 10- to 14-inch precipitation zone.

Dast series

The Dast series consists of moderately deep, well drained, rolling and hilly soils on sedimentary plains. These soils formed in material that weathered from soft sandstone of the Fort Union Formation. The native vegetation is mainly little bluestem, needleandthread, prairie sandreed, and western wheatgrass. It includes a few shrubs.

In a representative profile the surface layer is grayish brown fine sandy loam 5 inches thick. The underlying material is light brownish gray fine sandy loam and light yellowish brown very fine sandy loam 16 inches thick. Soft sandstone is at a depth of 21 inches.

Permeability is moderately rapid, and available water capacity is low.

Representative profile of Dast fine sandy loam in an area of Dast-Blanchard complex, 8 to 25 percent slopes, in grassland, 825 feet north and 1,650 feet east of the southwest corner of sec. 36, T. 23 N., R. 53 E.

A1—0 to 5 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, slightly sticky and nonplastic; many fine and medium roots; moderately alkaline; clear smooth boundary.

C1—5 to 14 inches; light brownish gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure; slightly hard, very friable, slightly sticky and nonplastic; common fine and medium roots; strongly effervescent; moderately alkaline; clear wavy boundary.

C2—14 to 21 inches; light yellowish brown (2.5Y 6/4) very fine sandy loam, light olive brown (2.5Y 5/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots; strongly effervescent; moderately alkaline; clear smooth boundary.

C3r—21 to 60 inches; light yellowish brown (2.5Y 6/4) soft sandstone, light olive brown (2.5Y 5/4) moist; few medium roots along fractures and cleavage planes; violently effervescent; moderately alkaline.

The A1 horizon is brown to grayish brown. The lower part of the C horizon is generally massive loam, very fine sandy loam, or fine sandy loam. Depth to soft sandstone ranges from 20 to 40 inches.

DbD—Dast-Blanchard complex, 8 to 25 percent slopes. These rolling and hilly soils are on sedimentary plains. The Dast soil makes up about 60 percent of this complex and the Blanchard soil about 30 percent.

Included in mapping and making up about 10 percent of the complex are areas of Tally, Shambo, and Lambert soils and blowouts, low dunes, and sandstone outcrops.

Runoff is slow to medium, and the hazard of erosion is high. These soils are used as range. Capability subclass VIe, dryland; Dast soil in Sandy range site, 10- to 14-inch precipitation zone, and Blanchard soil in Sands range site, 10- to 14-inch precipitation zone.

Dimyaw series

The Dimyaw series consists of deep, well drained, rolling to steep soils on uplands. These soils formed in silty clay sedimentary beds of the Fort Union Formation. The native vegetation is mainly little bluestem, western wheatgrass, and thickspike wheatgrass; it includes a few forbs and shrubs.

In a representative profile the surface layer is light brownish gray silty clay loam 4 inches thick. The underlying material, to a depth of 60 inches or more, is light gray silty clay loam.

Permeability is slow, and the available water capacity is high.

Representative profile of Dimyaw silty clay loam, 8 to 25 percent slopes, in grassland, 400 feet west and 2,000 feet south of the northeast corner of sec. 20, T. 26 N., R. 59 E.

A1—0 to 4 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate fine granular structure; slightly hard, friable, sticky and plastic; common fine and medium roots; strongly effervescent; mildly alkaline; clear smooth boundary.

C—4 to 60 inches; light gray (2.5Y 7/2) heavy silty clay loam, light brownish gray (2.5Y 6/2) moist; massive; hard, firm, sticky and plastic; few fine roots and pores; violently effervescent; moderately alkaline.

The A1 horizon is light brownish gray or grayish brown. The C horizon, below a depth of 40 inches, is silty clay or silty clay loam sedimentary beds with thin strata of claystone, siltstone, and soft lignite. The beds are light brownish gray, olive gray, light olive gray, light gray, and pale olive gray.

DmD—Dimyaw silty clay loam, 8 to 25 percent slopes. This rolling and hilly soil is on knobs and ridges in the uplands. A typical area has many spots and knobs of exposed sedimentary beds.

Included in mapping are small areas of Lambert, Blanchard, and Zahill soils. Also included are areas of a soil that has a silty clay surface layer.

Runoff is rapid, and the hazard of erosion is high. This soil is used as range. Capability subclass VIe, dryland; Thin Hilly range site, 10- to 14-inch precipitation zone.

Dooley series

The Dooley series consists of deep, well drained, gently sloping soils on terraces of the glaciated uplands. These soils formed in sandy alluvium. The native vegetation is mainly little bluestem, needleandthread, prairie sandreed, and western wheatgrass and includes a few shrubs.

In a representative profile the surface layer is dark grayish brown fine sandy loam 6 inches thick. The subsoil is dark grayish brown sandy clay loam over brown sandy loam and is 21 inches thick. The substratum is brown clay loam.

Permeability is moderate in the upper part of the

profile and moderately slow in the substratum. The available water capacity is high.

Representative profile of Dooley fine sandy loam, 2 to 6 percent slopes, in a cultivated fiield, 900 feet west and 400 feet north of the east quarter corner of sec. 29, T. 24 N., R. 59 E.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable, slightly sticky and nonplastic; many fine roots; mildly alkaline; abrupt smooth boundary.

B2t—6 to 15 inches; dark grayish brown (10YR 4/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure; hard, friable, sticky and plastic; common fine roots and pores; thin continuous clay films on vertical ped faces and clay bridging between sand grains; mildly alkaline; clear wavy boundary.

B3—15 to 27 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure; slightly hard, friable, nonsticky and nonplastic; few fine roots and pores; 3 percent pebbles; moderately alkaline; clear wavy boundary.

IIC—27 to 60 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; massive; hard, firm, sticky and plastic; few fine roots and pores; violently effervescent; common threads and soft nodules of lime; strongly alkaline.

Depth to carbonates ranges from 12 to 27 inches. Depth to clay loam glacial till ranges from 20 to 40 inches. Fine and medium sand occur at a depth of 40 inches or more in some pedons. The volume of gravel ranges from 0 to 15 percent throughout the profile.

DoB—Dooley fine sandy loam, 2 to 6 percent slopes. This gently sloping to sloping soil is on glaciated uplands. Included in mapping are small areas of Williams, Vida, Zahill, and Tally soils.

Runoff is slow to medium. The hazard of water erosion is moderate, and that of soil blowing is high. This soil is used for dryfarmed crops and as range. Capability unit IIIe-4, dryland; Sandy range site, 10- to 14-inch precipitation zone.

Farnuf series

The Farnuf series consists of deep, well drained, nearly level and gently sloping soils on fans and terraces and in swales on uplands. These soils formed in old alluvium. The native vegetation is mainly western wheatgrass and thickspike wheatgrass and includes a few forbs and shrubs.

In a representative profile the surface layer is dark grayish brown loam 10 inches thick. The subsoil is dark grayish brown and grayish brown clay loam 15 inches thick. The substratum is calcareous, light olive brown clay loam.

Permeability is moderate, and the available water capacity is high.

Representative profile of Farnuf loam, 0 to 2 percent slopes, in a cultivated fiield, 500 feet east and 600 feet south of the northwest corner of section 11, T. 21 N., R. 58 E.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) heavy loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine and medium roots; mildly alkaline; abrupt smooth boundary.

B2t—10 to 15 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure; hard, friable, sticky and plastic; common fine roots; thin clay films on vertical ped faces; mildly alkaline; gradual wavy boundary.

B3ca—15 to 25 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure; slightly hard, very friable, sticky and plastic; common fine roots; thin patchy clay films on some vertical ped faces; strongly effervescent; moderately alkaline; gradual wavy boundary.

Cca—25 to 60 inches; light olive brown (2.5Y 5/4) light clay loam, olive brown (2.5Y 4/4) moist; massive; hard, friable, sticky and plastic; few fine pores; violently effervescent; distinct threads and seams of lime; moderately alkaline.

The C horizon ranges from silt loam or silty clay loam to clay loam and is light brownish gray to light olive brown. Pebbles occur in the lower part of the C horizon in most pedons. Sand and gravel occur at a depth of more than 40 inches in some pedons.

FaA—Farnuf loam, 0 to 2 percent slopes. This nearly level soil is on fans and terraces. It has the profile described as representative of the series.

Included in mapping are small areas of Savage, Shambo, and Turner soils. Also included are small areas of soils that have a clay loam surface layer.

Runoff is slow, and the hazard of erosion is slight. Most areas are used for dryfarmed and irrigated crops. Capability units IIIc-2, dryland, and IIc-1, irrigated; Silty range site, 10- to 14-inch precipitation zone.

FaB—Farnuf loam, 2 to 4 percent slopes. This gently sloping soil is on fans and terraces. Included in mapping are small areas of Savage, Shambo, and Turner soils.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. This soil is used for dryfarmed and irrigated crops and as range. Capability units IIIe-2, dryland, and IIe-1, irrigated; Silty range site, 10- to 14-inch precipitation zone.

Havrelon series

The Havrelon series consists of deep, well drained, nearly level and gently sloping soils on low terraces and flood plains. These soils formed in stratified alluvium. The native vegetation is mainly western wheatgrass and includes a few forbs and shrubs.

In a representative profile the surface layer is grayish brown silt loam 8 inches thick. The underlying material, to a depth of 60 inches or more, is light brownish gray stratified silt loam, loam, and fine sandy loam.

Permeability is moderate, and the available water capacity is high.

Representative profile of Havrelon silt loam, 0 to 1 percent slopes, in a cultivated field, 500 feet south and 1,050 feet east of the west quarter corner of sec. 3, T. 22 N., R. 59 E.

Ap—0 to 8 inches; grayish brown (2.5Y 5/2) silt loam, dark grayish brown (2.5Y 4/2) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and medium

roots; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C—8 to 60 inches; light brownish gray (2.5Y 6/2) stratified loam, silt loam, and fine sandy loam, dark grayish brown (2.5Y 4/2) moist; massive with strata of weak coarse and very coarse plates; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium roots and pores; strongly effervescent; moderately alkaline.

The Ap horizon is light brownish gray to grayish brown silt loam or silty clay loam. The strata in the C horizon range from fine sandy loam to silty clay loam.

HaA—Havrelon silt loam, 0 to 1 percent slopes. This nearly level soil is on low terraces and flood plains. It has the profile described as representative of the series.

Included in mapping are small areas of Cherry, Lohler, and Trembles soils. Also included are small areas of soils that have a fine sandy loam or silty clay loam surface layer.

Runoff is very slow to slow, and the hazard of erosion is none to slight. Local areas are subject to flooding during unseasonably warm winters that cause ice jams on the major streams of the county. This soil is used for dryfarmed and irrigated crops and as range. Capability units IIIc-2, dryland, and IIc-1, irrigated; Silty range site, 10- to 14-inch precipitation zone.

HaB—Havrelon silt loam, 1 to 4 percent slopes. This nearly level and gently sloping soil is on terraces and flood plains.

Included in mapping are small areas of Cherry, Lohler, and Trembles soils. Also included are small areas of soils that have a silty clay loam or fine sandy loam surface layer.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. This soil is used for dryfarmed and irrigated crops and as range. Capability units IIIe-2, dryland, and IIe-1, irrigated; Silty range site, 10- to 14-inch precipitation zone.

Hb—Havrelon silty clay loam. This nearly level soil is on low terraces and flood plains. Slopes are 0 to 2 percent. The soil has a profile similar to the one described as representative of the series, except the surface layer is silty clay loam 6 to 20 inches thick.

Included in mapping are small areas of Cherry, Lohler, and Trembles soils.

Runoff is very slow to slow, and the hazard of erosion is none to slight. This soil is used for dryfarmed and irrigated crops and as range. Capability units IIIc-2, dryland, and IIc-1, irrigated; Clayey range site, 10- to 14-inch precipitation zone.

Hoffmanville series

The Hoffmanville series consists of deep, well drained, nearly level soils on low terraces and flood plains along the major streams in the county. These soils formed in alluvium. The native vegetation is mainly western wheatgrass, thickspike wheatgrass, and green needlegrass and includes a few forbs and shrubs.

In a representative profile the surface layer is grayish brown silty clay 9 inches thick. The underlying material consists of grayish brown silty clay in the upper 19 inches and below that, to a depth of more than 60 inches, light brownish gray loamy fine sand.

Permeability is slow to a depth of about 28 inches and is rapid below that. The available water capacity is moderate.

Representative profile of Hoffmanville silty clay in a cultivated field, 300 feet northeast of the southwest corner of sec. 24, T. 26 N., R. 59 E.

Ap—0 to 9 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate fine granular structure; very hard, firm, sticky and plastic; common fine roots; slightly effervescent; mildly alkaline; abrupt smooth boundary.

C1—9 to 28 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak coarse blocky structure; very hard, firm, sticky and plastic; few to common fine roots and pores; strongly effervescent; moderately alkaline; abrupt wavy boundary.

IIC2—28 to 60 inches; light brownish gray (2.5Y 6/2) loamy fine sand, grayish brown (2.5Y 5/2) moist; single grain; loose, very friable, nonsticky and nonplastic; 10 percent pebbles; strongly effervescent; moderately alkaline.

The A horizon is light brownish gray to grayish brown. The C1 horizon ranges from silty clay to silty clay loam and has thin strata of loam and silt loam in some pedons. The IIC2 horizon ranges from loamy fine sand to fine sand that is 10 to 35 percent pebbles, and it is at a depth of 24 to 36 inches.

Ho—Hoffmanville silty clay. This is a nearly level soil on low terraces and flood plains. Slopes are 0 to 2 percent.

Included in mapping are small areas of Havrelon, Lohler, Ridgelawn, and Trembles soils.

Runoff is very slow to slow, and the hazard of erosion is slight. Local areas are subject to flooding during unseasonably warm winters as a result of the ice jams on the major streams of the county. This soil is used for dryfarmed and irrigated crops and as range. Capability units IIIs-2, dryland, and IIs-1, irrigated; Clayey range site, 10- to 14-inch precipitation zone.

Lambert series

The Lambert series consists of deep, well drained, gently sloping to very steep soils on sedimentary plains. These soils formed in soft sedimentary beds of the Fort Union Formation. The native vegetation is mainly little bluestem, western wheatgrass, and thickspike wheatgrass and includes a few forbs and shrubs.

In a representative profile the surface layer is brown silt loam 4 inches thick. The underlying material, to a depth of 60 inches or more, is pale brown, very pale brown, and light yellowish brown calcareous silt loam.

Permeability is moderately slow, and the available water capacity is high.

Representative profile of Lambert silt loam, 2 to 8 percent slopes, in grassland, 10 feet north and 1,600 feet east of the southwest corner of sec. 18, T. 22 N., R. 57 E.

A1—0 to 4 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; moderate very fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; slightly effervescent; moderately alkaline; clear wavy boundary.

C1—4 to 14 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; slightly effervescent; moderately alkaline; gradual wavy boundary.

C2ca—14 to 18 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; weak coarse prismatic structure parting to moderate medium blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; violently effervescent; few indistinct threads and soft nodules of lime; moderately alkaline; gradual wavy boundary.

C3—18 to 60 inches; light yellowish brown (2.5Y 6/4) stratified silt loam and loam, light olive brown (2.5Y 5/4) moist; massive with strata of moderate medium platy structure; hard, friable, slightly sticky and slightly plastic; few fine roots and pores; violently effervescent; moderately alkaline.

The A1 horizon is light brownish gray to brown silt loam, but in some areas that are associated mainly with Tinsley soils it is gravelly loam. The C horizon is made up of sedimentary beds of stratified calcareous, soft to friable very fine sandy loam to silty clay loam. In some places strata of fine sandy loam cumulatively less than 6 inches thick, are part of the C horizon. The C horizon is brown, light gray, light yellowish brown, light brownish gray, very pale brown, pale yellow, pale olive, and white.

LaE—Lambert gravelly loam, 15 to 40 percent slopes. This moderately steep and steep soil is on hills and ridges of sedimentary plains. It has a profile similar to the one described as representative of the series except it has a 2- to 4-inch mantle of gravelly loam on the surface.

Included with this soil in mapping are small areas where slopes are less than 15 percent and areas where slopes are more than 40 percent. Also included are small areas of Dimyaw, Shambo, Tinsley, and Zahill soils.

Runoff is rapid to very rapid, and the hazard of erosion is high. This soil is used as range. Capability subclass VIe, dryland; Thin Hilly range site, 10- to 14-inch precipitation zone.

LbC—Lambert silt loam, 2 to 8 percent slopes. This gently sloping and sloping soil is on sedimentary plains. It is on long side slopes and low knobs and is severely eroded in some places. This soil has the profile described as representative of the series.

Included in mapping are small areas of Cherry, Dast, Shambo, and Vida soils.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for dryfarmed crops and as range. Capability unit IIIe-6, dryland; Silty range site, 10- to 14-inch precipitation zone.

LbD—Lambert silt loam, 8 to 15 percent slopes. This strongly sloping soil is on sedimentary plains. It is on side slopes and crests of ridges and hills. Areas of severely eroded soils are common.

Included in mapping are small areas of Dimyaw, Dast, Shambo, and Zahill soils.

Runoff is medium to rapid, and the hazard of erosion is high. This soil is used mainly as range. Capability unit IVe-4, dryland; Silty range site, 10- to 14-inch precipitation zone.

Lc—Lambert-Badland complex. This complex consists of steep to very steep soils on sedimentary plains on broken uplands. About 50 percent of this complex is Lambert soil and about 40 percent is Badland. The Lambert soil is steep; it is on short slopes and ridgetops. Areas of Lambert soils are divided by areas of Badland that are steep or very steep and have many deep gullies and outcrops of sedimentary beds. The Lambert soil has slopes of 20 to 40 percent. Badland ranges from 40 percent slopes to nearly vertical escarpments.

Included in mapping and making up about 10 percent of this complex are areas of Blanchard, Dimyaw, Dast, Ringling, Zahill, and Tinsley soils.

Runoff is very rapid, and the hazard of erosion is high to very high. This complex is used as range. Capability subclass VIe, dryland; Lambert soil in Thin Hilly range site, 10 to 14-inch precipitation zone.

LeD—Lambert-Blanchard complex, 8 to 25 percent slopes. This complex consists of rolling to moderately steep soils on sedimentary plains on uplands. The Lambert soil makes up about 50 percent of this complex and the Blanchard soil about 40 percent. The Blanchard soil has the profile described as representative of that series.

Included in mapping and making up about 10 percent of this complex are areas of Dast, Dimyaw, Tally, and Shambo soils. Numerous sandstone outcrops and low dunes are in most areas.

Runoff is slow to very rapid, and the hazard of erosion is high to very high. These soils are used mainly as range. Capability subclass VIe, dryland; Lambert soil in Thin Hilly range site, 10- to 14-inch precipitation zone, and Blanchard soil in Sands range site, 10- to 14-inch precipitation zone.

LfF—Lambert-Dimyaw complex, 15 to 65 percent slopes. This complex consists of hilly to very steep soils on dissected sedimentary plains. The Lambert soil makes up about 55 percent of the complex and the Dimyaw soil about 35 percent. The Dimyaw soil has the profile described as representative of that series. Areas of severely eroded soils are common.

Included in mapping and making up about 10 percent of the complex are areas of Blanchard, Dast, Ringling, and Zahill soils.

Runoff is rapid to very rapid, and the hazard of erosion is high. These soils are used as range. Capability subclass VIe, dryland; Thin Hilly range site, 10- to 14-inch precipitation zone.

LhF—Lambert-Ringling complex, 15 to 65 percent slopes. This complex consists of hilly to very steep soils on sedimentary plains.

The Lambert soil makes up 50 percent of the complex and the Ringling soil 30 percent. The Ringling soil has the profile described as representative of that series. In a typical area, the Lambert soil is on lower side slopes, and the Ringling soil is on upper slopes and ridgetops. The areas are characterized by numerous outcrops of reddish brown porcelanite.

Included in mapping and making up 20 percent of the complex are Cherry, Dast, Dimyaw, Shambo, and Zahill soils. Also included are areas where the slopes are more than 65 percent.

Runoff is rapid to very rapid, and the hazard of erosion is high. These soils are used as range. Ringling soil is also a source of surface material for some county

roads. Capability subclass VIe, dryland; Lambert soil in Thin Hilly range site, 10- to 14-inch precipitation zone, and Ringling soil in Very Shallow range site, 10- to 14-inch precipitation zone.

Lihen series

The Lihen series consists of deep, well drained, sloping and rolling soils on terraces and ridges. These soils formed in sandy alluvium. The native vegetation is mainly prairie sandreed, little bluestem, and sand bluestem and includes a few forbs and shrubs.

In a representative profile the surface layer is dark grayish brown loamy fine sand 30 inches thick. The underlying material, to a depth of 60 inches or more, is grayish brown loamy fine sand.

Permeability is rapid, and the available water capacity is moderate.

Representative profile of Lihen loamy fine sand, 4 to 15 percent slopes, in grassland, 400 feet west and 800 feet south of the east quarter corner of sec. 30, T. 23 N., R. 59 E.

A11—0 to 4 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; many fine and medium roots; neutral; clear wavy boundary.

A12—4 to 30 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak medium and coarse prismatic structure; soft, very friable, nonsticky and nonplastic; common fine and medium roots; mildly alkaline; gradual wavy boundary.

C—30 to 60 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; single grain; loose, moist or dry; common to few medium and fine roots; mildly alkaline.

The A1 horizon is 20 to 35 inches thick. The C horizon ranges from loamy fine sand to sandy loam.

LmD—Lihen loamy fine sand, 4 to 15 percent slopes. This sloping and rolling soil is on old stream terraces.

Included in mapping are small areas of Tinsley, Tally, Beaverton, and Turner soils. Also included are small areas that have a sandy loam surface layer.

Runoff is slow to medium. The hazard of soil blowing is high, but the hazard of water erosion is slight to moderate. This soil is used mainly as range. Capability subclass VIe, dryland; Sands range site, 10- to 14-inch precipitation zone.

Lohler series

The Lohler series consists of deep, moderately well drained, nearly level soils on low terraces and flood plains along the major streams in the county. These soils formed in stratified alluvium. The native vegetation is mainly western wheatgrass, thickspike wheatgrass, and green needlegrass. It includes a few forbs and shrubs.

In a representative profile the surface layer is grayish brown silty clay loam 8 inches thick. The underlying material, to a depth of 60 inches or more, is grayish brown and light olive gray silty clay loam and light brownish gray silty clay.

Permeability is moderately slow, and the available water capacity is high.

Representative profile of Lohler silty clay loam, in a cultivated field, 1,100 feet northeast of center of sec. 32, T. 22 N., R. 59 E.

Ap—0 to 8 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate fine granular structure; hard, friable, sticky and plastic; many worm casts and burrows; violently effervescent; moderately alkaline; abrupt smooth boundary.

C1—8 to 16 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure that parts to moderate fine subangular blocky; hard, friable, sticky and plastic; strongly calcareous; moderately alkaline; clear smooth boundary.

C2—16 to 25 inches, light olive gray (5Y 6/2) heavy silty clay loam, olive gray (5Y 5/2) moist; weak medium prismatic structure that parts to weak medium subangular blocky; hard, friable, sticky and plastic; common fine roots and pores; strongly calcareous; moderately alkaline; clear smooth boundary.

C3—25 to 60 inches; light brownish gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) moist; massive; very hard, firm, sticky and plastic; few fine pores; strongly calcareous; moderately alkaline.

The Ap horizon is light brownish gray to grayish brown and is silty clay loam, silty clay, or clay. Thin strata of fine sandy loam to silty clay are common in the C horizon.

Lo—Lohler silty clay loam. This is a nearly level soil on low terraces and flood plains. It has the profile described as representative of the series. Slopes are 0 to 2 percent.

Included with this soil in mapping are small areas where slopes are as much as 4 percent. Also included are small areas of Cherry, Havrelon, Marias, Ridgelawn, Hoffmanville, and Trembles soils.

Runoff is very slow to slow and the hazard of erosion is slight. Local areas are subject to flooding during unseasonably warm winters as a result of ice jams on the major streams of the county. This soil is used for dryfarmed and irrigated crops and as range. Capability units IIIs-4, dryland and IIs-3, irrigated; Clayey range site, 10- to 14-inch precipitation zone.

Lp—Lohler clay. This is a nearly level soil on low terraces and flood plains along the Yellowstone and Missouri Rivers. It has a profile similar to the one described as representative of the series, except the clay content is higher throughout the profile and the underlying material is strongly alkaline in places. Slopes are 0 to 2 percent.

Included in mapping are small areas of Havrelon and Vanda soils.

Runoff is very slow to slow, and the hazard of erosion is none to slight. Localized areas are subject to flooding during unseasonably warm winters when ice jams form on the major streams in the county. This soil is used for irrigated crops and as range. Capability units IIIs-4, dryland, and IIs-3, irrigated; Dense Clay range site, 10- to 14-inch precipitation zone.

Lw—Lohler clay, wet. This is a nearly level soil on low terraces and flood plains. It has a profile similar to the one described as representative of the series, except there are prominent mottles in the underlying

material and the water table is a few inches from the surface during the growing season. Slopes are 0 to 1 percent.

Included in mapping are small areas of Lohler, Vanda, and Benz soils. Also included are areas of Typic Haplaquents.

Runoff is very slow or is ponded. There is no hazard of erosion. Local areas are occasionally flooded during rainstorms or when ice jams form on the major streams. This soil is used mainly as range. A few areas are drained and used for irrigated hayland. Capability subclass VIw, dryland; Wetland range site, 10- to 14-inch precipitation zone.

Marias series

The Marias series consists of deep, well drained, nearly level soils on fans and terraces. These soils formed in clayey alluvium. The native vegetation is mainly western wheatgrass, thickspike wheatgrass, and green needlegrass, and includes a few forbs and shrubs.

In a representative profile the surface layer is grayish brown silty clay 5 inches thick. The underlying material, to a depth of 60 inches or more, is grayish brown, light brownish gray, and very dark gray silty clay.

Permeability is very slow, and the available water capacity is high.

Representative profile of Marias silty clay in grassland, 25 feet west and 2,500 feet north of the southeast corner of sec. 31, T. 27 N., R. 51 E.

A1—0 to 5 inches, grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; strong medium and fine granular structure; hard, friable, sticky and plastic; many fine roots; mildly alkaline; clear wavy boundary.

C1—5 to 14 inches, grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure that parts to strong medium angular blocky; hard, firm, sticky and plastic; common fine and medium roots; moderately alkaline; clear wavy boundary.

C2ca—14 to 37 inches, light brownish gray (10YR 6/2) silty clay, grayish brown (10YR 5/2) moist; strong coarse prismatic structure that parts to moderate medium subangular blocky; hard, firm, sticky and plastic; few fine and medium roots and pores; few small distinct slickensides; violently effervescent; strongly alkaline; clear wavy boundary.

A1bca—37 to 60 inches, very dark gray (10YR 3/1) silty clay, black (10YR 2/1) moist; moderate medium blocky structure; extremely hard, very firm, sticky and plastic; violently effervescent; common soft nodules of lime; strongly alkaline.

The C horizon is light brownish gray to grayish brown or gray to very dark gray. Silty clay is dominant, but ½- to 1-inch thick strata of sandy clay, silty clay loam, and silt loam occur in some pedons at a depth below 10 inches.

Ma—Marias silty clay. This is a nearly level soil on fans and terraces. Slopes are 0 to 2 percent.

Included in mapping are small areas of Cherry, Lohler, Savage, and Vanda soils.

Runoff is slow, and the hazard of erosion is slight. This soil is used for dryfarmed crops and as range. Capability units IIIs-4, dryland, and IIs-3, irrigated; Clayey range site, 10- to 14-inch precipitation zone.

Ridgelawn series

The Ridgelawn series consists of deep, well drained, nearly level soils on low terraces and flood plains. These soils formed in alluvium. The native vegetation is mainly western wheatgrass and thickspike wheatgrass and includes a few forbs and shrubs.

In a representative profile the surface layer is grayish brown loam 7 inches thick. The underlying material, to a depth of 60 inches or more, is grayish brown loam 17 inches thick over light brownish gray fine sand.

Permeability is moderate to a depth of about 24 inches and is rapid below. The available water capacity is moderate.

Representative profile of Ridgelawn loam 200 feet southeast of the west quarter corner of sec. 6, T. 21 N., R. 59 E.

Ap—0 to 7 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; strongly effervescent; moderately alkaline; abrupt smooth boundary.

C1—7 to 24 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; many fine and very fine pores; strongly effervescent; moderately alkaline; abrupt smooth boundary.

IIC2—24 to 60 inches; light brownish gray (2.5Y 6/2) fine sand, dark grayish brown (2.5Y 4/2) moist; single grain; loose, very friable, nonsticky and nonplastic; 10 percent pebbles; strongly effervescent; moderately alkaline.

The Ap horizon is light brownish gray to grayish brown. The C1 horizon ranges from loam to silty clay loam. The IIC horizon is generally at a depth of 24 to 36 inches, but ranges from 20 to 40 inches. It ranges from fine sand to loamy fine sand and is 10 to 35 percent pebbles.

Rd—Ridgelawn loam. This is a nearly level soil on low terraces and flood plains.

Included in mapping are small areas of Havrelon, Hoffmanville, Lohler, and Trembles soils. Also included are areas of a soil that has a silty clay loam surface layer that becomes cloddy if tilled while wet.

Runoff is slow, and the hazard of erosion is slight. Local areas are subject to flooding during unseasonably warm winters when the ice jams form on the major streams in the county. This soil is used for dryfarmed and irrigated crops and as range. Capability units IIIs-2, dryland, and IIs-1, irrigated; Silty range site, 10- to 14-inch precipitation zone.

Ringling series

The Ringling series consists of deep, well drained, hilly to very steep soils on ridges and knobs of sedimentary plains. These soils formed in material that weathered from shale beds of the Fort Union Formation. The native vegetation is mainly bluebunch wheatgrass, plains muhly, and little bluestem, and includes a few forbs and shrubs.

In a representative profile the surface layer is reddish brown channery loam 12 inches thick. The underlying material is angular cobble- and gravel-size fragments of red shale. Angular pebbles increase with depth throughout the profile.

Permeability is moderately rapid above 12 inches and is very rapid below. The available water capacity is very low.

Representative profile of Ringling channery loam, in an area of Lambert-Ringling complex, 15 to 65 percent slopes, 165 feet south and 990 feet west of the northeast corner of sec. 10, T. 26 N., R. 55 E.

A11—0 to 4 inches; reddish brown (5YR 4/3) channery loam, dark reddish brown (5YR 3/3) moist; moderate fine and very fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and medium roots; 15 percent hard fine and medium angular shale fragments; mildly alkaline; clear wavy boundary.

A12—4 to 12 inches; reddish brown (5YR 4/4) channery loam, dark reddish brown (5YR 3/4) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine and medium roots; 35 percent hard angular fragments; slightly effervescent; moderately alkaline; gradual wavy boundary.

IICr—12 to 36 inches; red (2.5YR 5/6) angular cobble- and gravel-size shale fragments; less than 5 percent fine earth of loam texture; few to no fine roots; medium to coarse pores; lime coatings on lower side of some fragments; strongly effervescent; moderately alkaline.

Depth to angular cobble and gravel-size shale fragments ranges from 10 to 20 inches. The A1 horizon is brown to reddish brown. Angular coarse fragments increase with depth from about 15 percent in the surface layer to nearly 100 percent in the lower part of the profile. The IICr horizon is light reddish brown, brown, reddish yellow, and red.

Ringling soils are mapped only in a complex with Lambert soils.

Riverwash

Rw—Riverwash. This is a nearly level miscellaneous area on flood plains along the rivers and dry stream channels. The areas are subject to annual flooding and typically consist of barren to nearly barren gravel and sand bars. Some areas have been partially stabilized by willows and other brushy vegetation.

Included in mapping are small areas of Banks soils.

Riverwash is used for wildlife habitat. It is also a source of sand and gravel for road building. Capability unit VIIIw, dryland.

Savage series

The Savage series consists of deep, well drained, nearly level and gently sloping soils on fans and terraces along the major streams and in swales on uplands. These soils formed in alluvium. The native vegetation is mainly western wheatgrass and thickspike wheatgrass and includes a few forbs and shrubs.

In a representative profile the surface layer is dark grayish brown silty clay loam 11 inches thick. The subsoil is grayish brown silty clay 8 inches thick. The substratum, to a depth of 60 inches or more, is light brownish gray silty clay loam.

Permeability is moderately slow, and the available water capacity is high.

Representative profile of Savage silty clay loam, 0 to 2 percent slopes, in a cultivated field, 800 feet north and 500 feet west of the east quarter corner of sec. 10, T. 23 N., R. 59 E.

Ap—0 to 11 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; slightly hard, friable, sticky and plastic; common worm burrows and casts; mildly alkaline; abrupt smooth boundary.

B2t—11 to 19 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure that parts to moderate medium blocky; hard, firm, sticky and plastic; common fine roots; mildly alkaline; gradual wavy boundary.

C1ca—19 to 25 inches; light brownish gray (10YR 6/2) heavy silty clay loam, grayish brown (10YR 5/2) moist; moderate medium prismatic structure; slightly hard, friable, sticky and plastic; few fine roots; violently effervescent; moderately alkaline; gradual wavy boundary.

C2—25 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; massive; hard, friable, sticky and plastic; violently effervescent; few distinct soft nodules and threads of lime; moderately alkaline.

The B horizon is silty clay or clay. The C horizon is silty clay, silty clay loam, or clay.

SaA—Savage silty clay loam, 0 to 2 percent slopes. This nearly level soil is on fans and terraces along major streams in the county. It has the profile described as representative of the series.

Included in mapping are small areas of Cherry, Farnuf, Marias, and Turner soils. Also included are small areas of soils that have a silty clay surface layer.

Runoff is very slow to slow, and the hazard of erosion is slight. This soil is used for dryfarmed and irrigated crops and as range. Capability units IIIe-2, dryland, and IIc-1, irrigated; Clayey range site, 10- to 14-inch precipitation zone.

SaB—Savage silty clay loam, 2 to 4 percent slopes. This gently sloping soil is on fans and terraces along major streams and in swales on uplands.

Included in mapping are small areas of Cherry, Bowbells, Turner, and Farnuf soils. Also included are small areas of soils that have a silty clay surface layer.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for dryfarmed crops and as range. Capability units IIIe-2, dryland, and IIe-1, irrigated; Clayey range site, 10- to 14-inch precipitation zone.

Shambo series

The Shambo series consists of deep, well drained, nearly level to rolling soils on side slopes, fans, and terraces and in swales throughout the county. The soils formed in alluvium and in material that weathered from sedimentary beds of the Fort Union Formation. The native vegetation is mainly western wheatgrass and thickspike wheatgrass and includes a few forbs and shrubs.

In a representative profile the surface layer is dark grayish brown loam 6 inches thick. The subsoil is dark grayish brown and grayish brown loam 25 inches thick. The substratum is light brownish gray calcareous loam.

Permeability is moderate, and the available water capacity is high.

Representative profile of Shambo loam, 0 to 2 percent slopes, in a cultivated field, 600 feet south and 150 feet west of the east quarter corner of sec. 29, T. 22 N., R. 59 E.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky and nonplastic; mildly alkaline; abrupt smooth boundary.

B2—6 to 14 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure; slightly hard, very friable, slightly sticky and nonplastic; common fine roots and pores; slightly effervescent; mildly alkaline; gradual wavy boundary.

B3ca—14 to 31 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure; slightly hard, very friable, slightly sticky and nonplastic; common fine roots and pores; violently effervescent; few fine threads of lime; moderately alkaline; clear wavy boundary.

C—31 to 60 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, very friable, slightly sticky and nonplastic; few fine roots and pores; strongly effervescent; few fine threads and soft nodules of lime; moderately alkaline.

The B and C horizons range from loam to silt loam. In some pedons, the C horizon has thin lenses of sandy loam and gravelly loam.

ShA—Shambo loam, 0 to 2 percent slopes. This nearly level soil is on fans and terraces. It has the profile described as representative of the series.

Included in mapping are small areas of Cherry, Turner, and Farnuf soils.

Runoff is slow, and the hazard of erosion is slight. This soil is used for dryfarmed and irrigated crops and as range. Capability units IIIc-2, dryland, and IIc-1, irrigated; Silty range site, 10- to 14-inch precipitation zone.

ShB—Shambo loam, 2 to 4 percent slopes. This gently sloping soil is on fans and terraces along streams on sedimentary plains.

Included in mapping are small areas of Cherry, Lambert, Farnuf, and Turner soils.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. The soil is used for dryfarmed and irrigated crops and as range. Capability units IIIe-2, dryland, and IIe-1, irrigated; Silty range site, 10- to 14-inch precipitation zone.

ShC—Shambo loam, 4 to 8 percent slopes. This undulating soil is on the sides of hills and ridges on sedimentary plains.

Included in mapping are small areas of Cherry, Lambert, and Tally soils.

Runoff is medium, and the hazard of erosion is moderate. This soil is used for dryfarmed crops and as range. Capability units IIIe-6 dryland, and IIIe-1, irrigated; Silty range site, 10- to 14-inch precipitation zone.

SmC—Shambo-Lambert complex, 4 to 8 percent slopes. This complex consists of undulating soils on sedimentary plains. The Shambo soil makes up about 50 percent of the complex and the Lambert soil about 40 percent. The Shambo soil is on side slopes and fans, and the Lambert soil is on ridge crests.

Included in mapping and making up about 10 percent of the complex are areas of Cherry, Dast, Tally, Farnuf, and Vida soils.

Runoff is medium, and the hazard of erosion is moderate. These soils are used for dryfarmed crops and as range. Capability IIIe-6, dryland; Silty range site, 10- to 14-inch precipitation zone.

SmD—Shambo-Lambert complex, 8 to 15 percent slopes. This complex consists of rolling soils on sedimentary plains. The Shambo soil makes up about 50 percent of the complex and the Lambert soil about 40 percent. The Shambo soil is on side slopes, and the Lambert soil is on the crests of hills and ridges.

Included in mapping and making up about 10 percent of the complex are areas of Dast, Dimyaw, Vida, and Zahill soils.

Runoff is rapid, and the hazard of erosion is moderate to high. These soils are used for dryfarmed crops and as range. Capability unit IVe-4, dryland; Silty range site, 10- to 14-inch precipitation zone.

Strip mines, reclaimed

St—Strip mines, reclaimed. This mapping unit consists of areas that have been disturbed by surface mining. The land has been reshaped, and vegetation has been reestablished. The soils are mostly gently sloping to strongly sloping, and they are steep in some places. The surface material ranges from loamy sand to clay.

This unit is used mainly as range and for wildlife habitat and recreation. Onsite investigation is needed to determine the capability unit and the range site.

Tally series

The Tally series consists of deep, well drained, nearly level to rolling soils on hills, ridges, side slopes, and fans on sedimentary plains. These soils formed in sandy alluvium and wind-deposited material derived from alluvium. The native vegetation is mainly little bluestem, needleandthread, prairie sandreed, and western wheatgrass and includes a few shrubs.

In a representative profile the surface layer is dark grayish brown fine sandy loam 7 inches thick. The subsoil is dark grayish brown fine sandy loam 9 inches thick. The substratum, to a depth of 60 inches or more, is light brownish gray fine sandy loam.

Permeability is moderately rapid, and the available water capacity is moderate.

Representative profile of Tally fine sandy loam, 0 to 2 percent slopes, in a cultivated field, 300 feet west and 100 feet north of the southeast corner of sec. 12, T. 22 N., R. 58 E.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky and nonplastic; common fine and medium roots; neutral; abrupt smooth boundary.

B2—7 to 16 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure; slightly hard, very friable, slightly sticky and nonplastic; common fine and medium roots and pores; slightly effervescent; mildly alkaline; gradual wavy boundary.

Cca—16 to 60 inches; light brownish gray (10YR 6/2) fine sandy loam, brown (10YR 4/3) moist; weak medium prismatic structure; soft, very friable, nonsticky and nonplastic; common medium roots to a depth of 48 inches, few below; strongly effervescent; moderately alkaline.

The B2 horizon is brown to dark grayish brown fine sandy loam or sandy loam. The Cca horizon is light brownish gray or grayish brown fine sandy loam or sandy loam, but it is loamy fine sand below a depth of 30 inches in some pedons. It ranges from noncalcareous to strongly calcareous. Some pedons have silt loam sedimentary beds or clay loam glacial till at a depth of 40 to 60 inches.

TaA—Tally fine sandy loam, 0 to 2 percent slopes. This nearly level soil is on fans and terraces along major streams and in swales on sedimentary plains. It has the profile described as representative of the series. In some cultivated areas, low ridges formed along the leeward edges of fallow strips as a result of soil blowing.

Included in mapping are small areas of Shambo, Turner, and Dooley soils.

Runoff is very slow to slow. The hazard of water erosion is slight, and the hazard of soil blowing is moderate to high. This soil is used for dryfarmed and irrigated crops and as range. Capability units IIIe-4, dryland, and IIe-3, irrigated; Sandy range site, 10- to 14-inch precipitation zone.

TaB—Tally fine sandy loam, 2 to 4 percent slopes. This gently sloping soil is on alluvial fans and in swales on sedimentary plains. In some cultivated areas, low ridges formed along the leeward edges of fallow strips as a result of soil blowing.

Included in mapping are small areas of Dast, Lihen, Shambo, and Turner soils.

Runoff is slow. The hazard of water erosion is moderate, and the hazard of soil blowing is moderate to high. This soil is used for dryfarmed and irrigated crops and as range. Capability units IIIe-4, dryland, and IIIe-3, irrigated; Sandy range site, 10- to 14-inch precipitation zone.

TaC—Tally fine sandy loam, 4 to 12 percent slopes. This undulating and rolling soil is on sedimentary plains. In some cultivated areas, low ridges formed along the leeward edges of fallow strips as a result of soil blowing.

Included in mapping are small areas of Blanchard, Dast, Lihen, and Shambo soils.

Runoff is slow to medium. The hazard of water erosion is moderate to high, and the hazard of soil blowing is high. The soil is used for dryfarmed crops and as range. Capability unit IVe-6, dryland; Sandy range site, 10- to 14-inch precipitation zone.

Tinsley series

The Tinsley series consists of deep, excessively drained, moderately steep to very steep soils on edges of high terraces and benches on uplands. These soils formed in gravelly and sandy outwash deposits. The native vegetation is mainly plains muhly, needleandthread, and bluebunch wheatgrass and includes some forbs and shrubs.

In a representative profile the surface layer is grayish brown gravelly sandy loam 3 inches thick. The underlying material is grayish brown gravelly sand in the upper 8 inches and light brownish gray very gravelly sand to a depth of 60 inches or more.

Permeability is rapid, and the available water capacity is very low.

Representative profile of Tinsley gravelly sandy loam, in an area of Tinsley soils, 15 to 65 percent slopes, in grassland, 1,000 feet east and 600 feet south of the northwest corner of sec. 30, T. 23 N., R. 59 E.

A1—0 to 3 inches; grayish brown (2.5Y 5/2) gravelly sandy loam, dark grayish brown (2.5Y 4/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; 15 percent pebbles; mildly alkaline; clear wavy boundary.

C1—3 to 11 inches; grayish brown (2.5Y 5/2) gravelly sand, dark grayish brown (2.5Y 4/2) moist; single grain; loose; few fine and very fine roots; 35 percent pebbles; mildly alkaline; gradual wavy boundary.

C2—11 to 60 inches; light brownish gray (2.5Y 6/2) very gravelly sand, grayish brown (2.5Y 5/2) moist; single grain; loose; few fine and very fine roots; 65 percent pebbles; strongly effervescent; thin lime crusts on underside of most pebbles; moderately alkaline.

The A horizon is light brownish gray to dark grayish brown and is gravelly sandy loam or gravelly loamy sand. The C horizon ranges from gravelly sand to very gravelly sand. The soil is noncalcareous in some pedons.

TeF—Tinsley soils, 15 to 65 percent slopes. This undifferentiated unit consists of Tinsley gravelly sandy loam and Tinsley gravelly loamy sand. These are moderately steep to very steep soils at the edges of high terraces and benches on uplands and along the Yellowstone River Valley. Any particular area consists of one or both soils in varying proportions. The soils are similar in use and management.

Included with this unit in mapping on some very steep edges of terraces is a soil that has a gravelly loam surface layer. Also included in mapping are small areas of Beaverton, Lambert, Lihen, Farnuf, Turner, and Zahill soils.

Runoff is very slow to slow. The hazard of water erosion is moderate, and the hazard of soil blowing is very high. This unit is used as range. Capability subclass VIIs, dryland; Gravel range site, 10- to 14-inch precipitation zone.

Trembles series

The Trembles series consists of deep, well drained, nearly level to sloping soils on low terraces and flood plains. These soils formed in stratified alluvium. The native vegetation is mainly little bluestem, needleandthread, prairie sandreed, and western wheatgrass and includes a few shrubs.

In a representative profile the surface layer is grayish brown fine sandy loam 7 inches thick. The underlying material, to a depth of 60 inches or more, is light brownish gray fine sandy loam with thin lenses of loam and loamy fine sand.

Permeability is moderately rapid, and the available water capacity is moderate.

Representative profile of Trembles fine sandy loam, in a cultivated field, one-fourth mile east and 1,200 feet north of the west quarter corner of sec. 8, T. 23 N., R. 60 E.

Ap—0 to 7 inches; grayish brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak fine granular structure; slightly hard, very friable, nonsticky and nonplastic; few fine roots; strongly effervescent; moderately alkaline; abrupt smooth boundary.

C1—7 to 30 inches; light brownish gray (2.5Y 6/2) fine sandy loam and a few ¼- to 1-inch thick lenses of loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; many fine and very fine pores; strongly effervescent; moderately alkaline; diffuse wavy boundary.

C2—30 to 60 inches; light brownish gray (2.5Y 6/2) fine sandy loam and ¼- to 1-inch thick lenses of loamy fine sand, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; many pores decreasing to few; strongly effervescent; moderately alkaline.

The C horizon is typically fine sandy loam, but ranges from very fine sandy loam to loamy very fine sand. It commonly has thin strata of clay loam to loamy sand.

Tm—Trembles fine sandy loam. This is a nearly level and gently sloping soil on low terraces and flood plains. Slopes range from 0 to 4 percent, but are typically less than 2 percent.

Included in mapping are small areas of Banks, Ridgelawn, Hoffmanville, Lohler, Havrelon, Cherry, and Benz soils. Also included are small areas of soils that have a loam and loamy fine sand surface layer.

Runoff is very slow to slow. The hazard of water erosion is moderate, and the hazard of soil blowing is high. Local areas are subject to flooding during unseasonably warm winters when there are ice jams on major streams in the county. This soil is used for dryfarmed and irrigated crops and as range. Capability units IIIe-4, dryland, and IIIe-3, irrigated; Sandy range site, 10- to 14-inch precipitation zone.

Turner series

The Turner series consists of deep, well drained, nearly level and gently sloping soils on terraces. These soils formed in old alluvium underlain by sand and gravel at a depth of 20 to 40 inches. The native vegetation is mainly western wheatgrass and thickspike wheatgrass and includes a few forbs and shrubs.

In a representative profile the surface layer is dark grayish brown clay loam 11 inches thick. The subsoil is grayish brown clay loam 11 inches thick. The substratum is calcareous, grayish brown gravelly clay loam in the upper 4 inches and is grayish brown, very gravelly loamy sand to a depth of 60 inches or more.

Permeability is moderate to a depth of about 26 inches and rapid below that. The available water capacity is moderate.

Representative profile of Turner clay loam in an area of Turner-Beaverton complex, 0 to 4 percent slopes, in a cultivated field, 400 feet west and 100 feet south of the north quarter corner of sec. 27, T. 23 N., R. 59 E.

Ap—0 to 11 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and medium roots and pores; mildly alkaline; abrupt smooth boundary.

B2t—11 to 16 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure that parts to moderate fine subangular blocky; friable, sticky and plastic; common fine and medium roots and pores; thin clay films on vertical ped faces; mildly alkaline; clear wavy boundary.

B3t—16 to 22 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure; hard, friable, sticky and plastic; common fine roots and pores; few thin clay films; slightly effervescent; clear wavy boundary.

C1ca—22 to 26 inches; grayish brown (10YR 5/2) gravelly clay loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure; hard, friable, slightly plastic; few fine roots and pores; 15 percent pebbles; violently effervescent; common threads and soft nodules of lime; moderately alkaline; clear wavy boundary.

IIC2—26 to 60 inches; grayish brown (10YR 5/2) very gravelly loamy sand, dark grayish brown (10YR 4/2) moist; single grain; loose; 75 percent pebbles; violently effervescent; moderately alkaline.

The B2t horizon ranges from dark grayish brown to brown and grayish brown. Most pedons have a calcareous B3 horizon. The C1ca horizon, where present, is calcareous clay loam to sandy clay loam and is 0 to 15 percent gravel. Depth to very gravelly material is 20 to 40 inches.

ToB—Turner-Beaverton complex, 0 to 4 percent slopes. This complex consists of nearly level and gently sloping soils on terraces. About 55 percent of this complex is Turner soil and about 35 percent is Beaverton soil. The Turner and Beaverton soils have the profiles described as representative of their respective series.

Included in mapping and making up 10 percent of this complex are areas of Farnuf, Savage, and Shambo soils. Also included are small areas of soils that have a loam surface layer.

Runoff is slow, and the hazard of erosion is slight. This complex is used for dryfarmed and irrigated crops and as range. Capability units IIIs-2, dryland, and IIIe-5, irrigated; Turner soil in Silty range site, 10- to 14-inch precipitation zone, and Beaverton soil in Shallow to Gravel range site, 10- to 14-inch precipitation zone.

Typic Haplaquents

Tw—Typic Haplaquents. These are nearly level areas of poorly drained, stratified loamy soils that contain such large quantities of soluble salts and alkali that only the most salt-tolerant species of native plants will grow on them. Most areas have a white salt crust on the surface and numerous seams of salt crystals throughout the profile. Texture ranges from sandy loam to clay, but it is dominantly loam or clay loam. The water table is generally at or within a few inches of the surface during most of the growing season.

Included in mapping are small areas of Benz, Cherry, Havrelon, Lohler, and Trembles soils.

Surface runoff is very slow or ponded. There is no

hazard of erosion. These areas are used for wildlife habitat and as range. Capability subclass VIw, dryland; Saline Lowland range site, 10- to 14-inch precipitation zone.

Vanda series

The Vanda series consists of deep, well drained, nearly level to gently sloping soils on fans and terraces. These soils formed in clayey alluvium. The native vegetation is mainly western wheatgrass and thickspike wheatgrass and includes a few forbs and shrubs.

In a representative profile the surface layer is light olive gray clay 8 inches thick. The underlying material, to a depth of 60 inches or more, is light gray and light olive gray clay.

Permeability is very slow, and the available water capacity is moderate.

Representative profile of Vanda clay, in a cultivated field, 1,000 feet south and 400 feet west of the northeast corner of sec. 2, T. 23 N., R. 59 E.

Ap—0 to 8 inches; light olive gray (5Y 6/2) clay, olive gray (5Y 4/2) moist; weak fine granular structure; extremely hard, very firm, very sticky and plastic; few fine roots and pores; massive, and the upper 1 inch has many fine to medium vesicular pores; slightly effervescent; strongly alkaline; abrupt smooth boundary.

C1—8 to 23 inches; light gray (5Y 7/2) clay, olive gray (5Y 5/2) moist; moderate fine angular blocky structure; extremely hard, very firm, very sticky and plastic; few fine and very fine roots and pores; few lime and gypsum nodules; calcareous; very strongly alkaline; gradual wavy boundary.

C2—23 to 60 inches; light olive gray (5Y 6/2) clay, olive gray (5Y 5/2) moist; massive; extremely hard, very firm, very sticky and plastic; few fine pores; few fine threads and soft nodules of lime and gypsum; calcareous; very strongly alkaline.

In grassland, the A horizon is light gray to light brownish gray and massive with a vesicular crust ½ to 2 inches thick. It is silt loam or silty clay loam. In cultivated areas, the A horizon is light olive gray to olive gray clay. The C horizon ranges from clay to silty clay loam. Reaction ranges from moderately alkaline to strongly alkaline in the A horizon and from moderately alkaline to very strongly alkaline in the C horizon. Few to many threads and soft nodules of lime and gypsum occur below a depth of 15 inches.

Va—Vanda clay. This is a nearly level and gently sloping soil on fans and terraces. Slopes are 0 to 4 percent.

Included in mapping are small areas of Marias, Lohler, and Cherry soils. Also included are a few small areas of soils that have a silt loam or silty clay loam surface layer. In places, the underlying material is heavy clay.

Runoff is very slow to slow, and the hazard of erosion is moderate. This soil is used mainly as range. A few areas are used for irrigated hayland or pasture. Capability subclass VIe, dryland; Dense Clay range site, 10- to 14-inch precipitation zone.

Vida series

The Vida series consists of deep, well drained, nearly level to rolling soils on glaciated uplands. These soils formed in calcareous clay loam glacial till. The native vegetation is mainly western wheatgrass and thickspike wheatgrass. It includes a few forbs and shrubs.

In a representative profile the surface layer is brown clay loam 6 inches thick. The subsoil is brown clay loam 13 inches thick. The substratum, to a depth of 60 inches or more, is very pale brown gravelly clay loam glacial till.

Permeability is moderately slow, and the available water capacity is high.

Representative profile of Vida clay loam, 1 to 4 percent slopes, in a cultivated field, 1,650 feet south and 600 feet east of the northwest corner of sec. 7, T. 22 N., R. 57 E.

Ap—0 to 6 inches; brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; 10 percent pebbles; moderately alkaline; abrupt smooth boundary.

B2t—6 to 9 inches; brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate medium and coarse prismatic structure that parts to moderate medium subangular blocky; hard, friable, sticky and plastic; common fine and medium roots and pores; thin continuous clay films on vertical ped faces; 10 percent pebbles; moderately alkaline; clear wavy boundary.

B3ca—9 to 19 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; moderate coarse prismatic structure; hard, friable, sticky and plastic; common fine and medium roots and pores; few thin patchy clay films; 10 percent pebbles; violently effervescent; common soft nodules and fine threads of lime; moderately alkaline; gradual wavy boundary.

C—19 to 60 inches; very pale brown (10YR 7/3) gravelly clay loam, pale brown (10YR 6/3) moist; weak coarse prismatic structure; hard firm, sticky and plastic; few fine and medium roots and pores; 15 percent pebbles; strongly effervescent; strongly alkaline.

The A horizon is brown to dark grayish brown. In grassland, it is loam; and where cultivated, it is clay loam. Thickness of the noncalcareous A and B horizons combined ranges from 6 to 10 inches. The B3ca horizon is light brownish gray or brown. The C horizon is light brownish gray to light gray and very pale brown clay loam glacial till. The profile contains 10 to 25 percent coarse fragments, mainly pebbles, but in some pedons cobbles and a few stones are included.

VdB—Vida clay loam, 1 to 4 percent slopes. This nearly level and gently undulating soil is on glaciated uplands. It has the profile described as representative of the series. A few stones are scattered on the surface.

Included in mapping are small areas of Bowbells, Williams, Zahill, and Dooley soils.

Runoff is slow to medium, and the hazard of erosion is slight. This soil is used for dryfarmed crops and as range. Capability unit IIIe-2, dryland; Silty range site, 10- to 14-inch precipitation zone.

VdC—Vida clay loam, 4 to 8 percent slopes. This undulating soil is on glaciated uplands. It occupies long side slopes on rolling landscapes, and has a few stones scattered on the surface.

Runoff is medium to rapid, and the hazard of erosion is moderate. This soil is used for dryfarmed crops and as range. Capability unit IIIe-6, dryland; Silty range site, 10- to 14-inch precipitation zone.

VhC—Vida-Zahill complex, 4 to 8 percent slopes. This undulating complex is on glaciated uplands. About 50 percent of this complex is Vida soil and about 35 per-

cent is Zahill soil. The Vida soil is on the smoother, least sloping parts of the landscape, and the Zahill soil is on ridges. A few cobbles and stones are scattered on the surface.

Included in mapping and making up about 15 percent of the complex are areas of Williams and Bowbells soils in swales.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. This complex is used for dryfarmed crops and as range. Capability unit IIIe-6, dryland; Silty range site, 10- to 14-inch precipitation zone.

VhD—Vida-Zahill complex, 8 to 15 percent slopes. This rolling complex is on glaciated uplands. About 50 percent of the complex is Vida soil and about 40 percent is Zahill soil. The Vida soil is on lower side slopes, and the Zahill soil is on crests of ridges and hills. The soils have profiles similar to the ones described as representative of their respective series, except the surface layer is loam where the soils have not been cultivated. Also a few stones and cobbles are scattered on the surface.

Included in mapping and making up 10 percent of the complex are areas of Williams and Bowbells soils in swales.

Runoff is rapid, and the hazard of erosion is high. The complex is used mainly as range. A few small areas are used for dryfarmed crops. Capability unit IVe-4, dryland; Silty range site, 10- to 14-inch precipitation zone.

Williams series

The Williams series consists of deep, well drained, nearly level and gently undulating soils that formed in calcareous clay loam glacial till. The native vegetation is mainly western wheatgrass and thickspike wheatgrass and includes a few forbs and shrubs.

In a representative profile the surface layer is dark grayish brown loam 7 inches thick. The subsoil is dark grayish brown, grayish brown, and light brownish gray clay loam 21 inches thick. The lower part of the subsoil is calcareous. The substratum, to a depth of 60 inches or more, is light brownish gray clay loam glacial till.

Permeability is moderately slow, and the available water capacity is high.

Representative profile of Williams loam, 0 to 4 percent slopes, in a cultivated field, 660 feet south and 100 feet east of the northwest corner of sec. 21, T. 21 N., R. 57 E.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; mildly alkaline; abrupt smooth boundary.

B21t—7 to 15 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure that parts to moderate medium subangular blocky; slightly hard, friable, sticky and plastic; common fine and medium roots and pores; thin continuous clay films on vertical ped faces; mildly alkaline; gradual smooth boundary.

B22t—15 to 21 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure; hard, friable, sticky and plastic; common fine and medium roots and pores; thin patchy clay films; mildly alkaline; gradual wavy boundary.

B3ca—21 to 28 inches; light brownish gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; weak coarse prismatic structure that parts to moderate medium subangular blocky; hard, firm, sticky and plastic; common fine and medium pores and roots; strongly effervescent; many threads and soft nodules of lime; strongly alkaline; gradual wavy boundary.

C—28 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; weak coarse prismatic structure that parts to moderate fine subangular blocky; hard, firm, sticky and plastic; few fine and medium roots and pores; calcareous; common threads and soft nodules of lime; strongly alkaline.

This soil contains 0 to 10 percent pebbles.

WmB—Williams loam, 0 to 4 percent slopes. This nearly level and gently undulating soil is on the smoothest part of glaciated uplands. Included in mapping are small areas of Vida, Bowbells, Dooley, and Zahill soils.

Runoff is very slow to medium, and the hazard of erosion is slight. This soil is used for dryfarmed crops and as range. Capability unit IIIe-2, dryland; Silty range site, 10- to 14-inch precipitation zone.

Zahill series

The Zahill series consists of deep, well drained, moderately steep to very steep soils on hills, ridges, and knolls. These soils formed in calcareous clay loam glacial till. The native vegetation is mainly little bluestem, western wheatgrass, and thickspike wheatgrass. It includes a few forbs and shrubs.

In a representative profile the surface layer is dark grayish brown loam 4 inches thick. The underlying material, to a depth of 60 inches or more, is grayish brown and light brownish gray clay loam.

Permeability is moderately slow, and the available water capacity is high.

Representative profile of Zahill loam, 15 to 65 percent slopes, in grassland, 2,260 feet east and 825 feet north of the southwest corner of sec. 32, T. 25 N., R. 51 E.

A1—0 to 4 inches; dark grayish brown (10 YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; 15 percent pebbles; slightly effervescent; moderately alkaline; clear smooth boundary.

C1—4 to 16 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure that parts to moderate fine subangular blocky; hard, firm, sticky and plastic; many fine and medium roots and pores; 15 percent pebbles; strongly effervescent; common threads of lime and lime casts on pebbles; moderately alkaline; diffuse smooth boundary.

C2—16 to 60 inches; light brownish gray (10YR 7/2) clay loam, grayish brown (10YR 5/2) moist; weak coarse prismatic structure; hard, firm, sticky and plastic; few fine and medium roots and pores; 15 percent pebbles; violently effervescent; common threads of lime and lime casts on pebbles; strongly alkaline.

The A horizon is light brownish gray to dark grayish brown. In grassland, it is loam; and in a cultivated field, it is clay loam. Pebbles, cobbles, and stones make up 15 to 30 percent of the soil.

ZaF—Zahill loam, 15 to 65 percent slopes. This moderately steep to very steep soil is on the dissected edges of glaciated uplands. It has the profile described as representative of the series.

Included in mapping are small areas of Vida, Williams, and Lambert soils.

Runoff is rapid, and the hazard of erosion is high. This soil is used as range. Capability subclass VIe, dryland; Thin Hilly range site, 10- to 14-inch precipitation zone.

ZbF—Zahill-Lambert complex, 15 to 65 percent slopes. This complex consists of moderately steep to very steep soils on the dissected edges of glaciated uplands where they border sedimentary plains. About 45 percent of this complex is Zahill soil and about 35 percent is Lambert soil. The Zahill soil has a profile similar to the one described as representative of that series, but the surface layer is loam. The Zahill soil is on upper hillsides and ridge crests. The Lambert soil is on lower side slopes.

Included in mapping and making up 20 percent of the complex are areas of Vida, Shambo, Williams, and Tinsley soils.

Runoff is rapid to very rapid, and the hazard of erosion is high. This complex is used as range. Capability subclass VIe, dryland; Thin Hilly range site, 10- to 14-inch precipitation zone.

Use and management of the soils

The soils of Richland County are used mostly for crops and as range. This section tells how the soils are used for these purposes and for building roads, farm ponds, and other engineering structures. It also provides information on managing soils for urban-related land uses, for selected recreation uses, for windbreaks, and for wildlife habitat.

Elevation ranges from 1,800 feet on flood plains of the Yellowstone and Missouri Rivers in the northeast corner of the county to 2,900 feet on the divide between the drainageways of the Yellowstone and Redwater Rivers. The frost-free season is 110 to 130 days, and the average annual precipitation is about 13 inches. The mean annual air temperature is 41° to 43° F.

Crops

About 40 percent of the acreage of Richland County is used for crops and pasture. The main cultivated crops are alfalfa and grass. Table 2 lists estimated yields of the principal crops in the county under a high level of management. The results of soil tests should be used to indicate the need for fertilizer.

Fertilizer

The use of fertilizer in Richland County has increased steadily in recent years, but rates of applications are still low. Small amounts of nitrogen and phosphorus are drilled in the ground as dryfarmed small grain is seeded. A typical application consists of 10 to 15 pounds of nitrogen and 25 to 30 pounds of phosphorus per acre. Research is conducted locally on topdressing winter and spring wheat with additional nitrogen.

Experience and research have shown that dryfarmed wheat, barley, and oats respond well to applications of nitrogen and phosphorus if the soils are moist to a depth of 30 inches or more at seeding time. Research in Richland County and in other areas where soils and climatic conditions are similar indicates that good response could be expected from much larger applications of fertilizer.

The use and rates of application of fertilizer are more variable on irrigated crops than on dryfarmed crops. In addition to nitrogen and phosphorus, some crops on some soils may need other fertilizers.

Soil tests should be used to determine the fertilizer needs of specific crops on any given field. The information provided by these tests can help to avoid the costly error of applying a fertilizer that is not needed or applying insufficient amounts of those that are needed.

Capability grouping

Capability grouping generally shows the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or for engineering.

In the capability system, the kinds of soil are grouped at three levels: the capability class, the subclass, and the unit. These are discussed in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

- Class I soils have few limitations that restrict their use.
- Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
- Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.
- Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.
- Class V soils are subject to little or no erosion but

TABLE 2.—*Estimated average acre yields of major irrigated*

[Mapping units not listed or dashes in columns indicate

Soil	Dryland winter wheat	Dryland spring wheat	Barley		Oats	
			Dryland	Irrigated	Dryland	Irrigated
	Bu	*Bu*	*Bu*	*Bu*	*Bu*	*Bu*
Banks loamy fine sand, 0 to 4 percent slopes	...	...	...	45	...	50
Bowbells silt loam, 0 to 4 percent slopes	40	35	55	...	70	...
Cherry silty clay loam, 0 to 2 percent slopes	30	24	38	75	45	100
Cherry silty clay loam, 2 to 4 percent slopes	30	24	38	75	45	95
Cherry silty clay loam, 4 to 8 percent slopes	28	22	32	...	40	...
Cherry, Havrelon, and Trembles soils, occasionally flooded	...	...	...	...	...	...
Dooley fine sandy loam, 2 to 6 percent slopes	36	30	50	...	65	...
Farnuf loam, 0 to 2 percent slopes	36	30	50	95	50	100
Farnuf loam, 2 to 4 percent slopes	32	26	45	85	50	100
Havrelon silt loam, 0 to 1 percent slopes	28	25	40	80	48	100
Havrelon silt loam, 1 to 4 percent slopes	25	25	38	75	45	90
Havrelon silty clay loam	28	25	40	80	45	100
Hoffmanville silty clay	28	25	40	80	45	100
Lambert silt loam 2 to 8 percent slopes	22	18	28	...	34	...
Lambert silt loam, 8 to 15 percent slopes	16	12	20	...	25	...
Lohler silty clay loam	28	22	38	75	45	100
Lohler clay	26	22	38	70	45	90
Lohler clay, wet	...	...	...	...	...	...
Marias silty clay	30	24	38	70	40	75
Ridgelawn loam	26	20	40	80	48	100
Savage silty clay loam, 0 to 2 percent slopes	30	24	40	80	45	100
Savage silty clay loam, 2 to 4 percent slopes	30	24	40	80	45	100
Shambo loam, 0 to 2 percent slopes	30	24	40	80	45	100
Shambo loam, 2 to 4 percent slopes	30	24	40	80	45	100
Shambo loam, 4 to 8 percent slopes	28	22	38	...	40	...
Shambo-Lambert complex, 4 to 8 percent slopes	25	20	34	...	36	...
Shambo-Lambert complex, 8 to 15 percent slopes	22	16	30	...	33	...
Tally fine sandy loam, 0 to 2 percent slopes	25	22	32	80	36	95
Tally fine sandy loam, 2 to 4 percent slopes	25	22	32	75	36	90
Tally fine sandy loam, 4 to 12 percent slopes	22	...	28	...	30	...
Trembles fine sandy loam	25	22	32	75	36	90
Turner-Beaverton complex, 0 to 4 percent slopes	21	16	28	60	40	70
Vida clay loam, 1 to 4 percent slopes	36	30	46	...	62	...
Vida clay loam, 4 to 8 percent slopes	34	26	42	...	58	...
Vida-Zahill complex, 4 to 8 percent slopes	30	24	40	...	55	...
Vida-Zahill complex, 8 to 15 percent slopes	28	22	36	...	48	...
Williams loam, 0 to 4 percent slopes	38	32	50	...	65	...

AUM is animal-unit-months, a term used to express the carrying capacity of pasture. It is the number of animal units per acre horse, five hogs, or seven sheep has a carrying capacity of 1 animal-unit-month.

and dryland crops under a high level of management
that the crops are not commonly grown on the soil]

Corn silage		Sugar beets	Beans	Alfalfa hay		Hay crops, annuals	Grass-legume hay	Grass hay	Pasture	
Dryland	Irrigated	Irrigated	Irrigated	Dryland	Irrigated	Dryland	Dryland	Dryland	Dryland	Irrigated
Tons	*Tons*	*Tons*	*Bu*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*AUM*[1]	*AUM*[1]
	10	12			2				0.6	6
6				2.3		2.8	2.0	1.3	1.3	
5	26	18	43	1.7	5	2.0	1.2	1.0	1.0	9
5	24	17	40	1.7	5	2.0	1.2	1.0	1.0	9
	18			1.3	3	1.5	1.0	.8	.9	
								1.5	1.5	
5				1.8		2.3	1.5	1.1	1.1	
5	26	22	47	2.0	5	2.4	1.5	1.1	1.0	9
5	26	20	43	2.0	5	2.2	1.5	1.1	1.0	9
4	26	18	43	1.5	5	1.7	1.5	1.0	1.0	8
4	24	17	40	1.5	5	1.7	1.5	1.0	1.0	8
4	26	18	43	1.5	5	1.7	1.5	1.0	1.0	8
4	26	18	43	1.5	5	1.7	1.5	1.0	1.0	8
						1.0	.9	.6	.7	
						.7	.5	.5	.5	
4	26	18	43	1.7	5	2.0	1.5	1.1	1.0	9
4	15	16	27	1.7	5	2.0	1.5	.9	.9	7
							1.6	1.1	1.0	
3	15	16	27	1.7	5	2.3	1.5	.9	.9	7
4	26	18	43	1.7	5	2.0	1.5	1.0	1.0	9
5	26	22	40	2.0	5	2.4	1.5	1.0	1.0	9
5	26	21	37	2.0	5	2.4	1.5	1.0	1.0	9
5	26	22	41	2.0	5	2.4	1.5	1.1	1.0	9
5	26	22	38	2.0	5	2.4	1.5	1.1	1.0	8
3	22			1.5		2.2	1.3	1.0	1.0	
2				1.2		2.0	1.1	.6	.8	
						1.5	.7	.5	.7	
3	22	15	37	1.8	5	2.0	1.2	1.0	1.0	8
2	22	15	37	1.8	4	2.0	1.2	1.0	1.0	7
				1.2		1.5	1.0	.8	.8	
3	22	14	37	1.5	4	1.8	1.0	.8	.8	7
2	18	16	31	1.0	3	.9	.8	.5	.5	5
5				2.0		2.3	1.5	1.1	1.0	
				1.8		2.0	1.3	.10	1.0	
				1.6		1.8	1.3	.9	.9	
				1.4		1.6	1.2	.9	.9	
5				2.0		2.5	1.6	1.2	1.1	

a pasture can carry each month without injury to the soil. An acre of pasture that provides 1 month of grazing for one cow or

have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife habitat.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, or water supply, or to esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife habitat, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 or IIIe-6. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the capability units and subclasses in Richland County are described and suggestions for the use and management of the soils are given. To find the capability unit for any given soil, refer to the "Guide to mapping units" at the back of this survey.

Dryland management

Most of the cropland in Richland County is dryfarmed to wheat, barley, and oats in rotation with a year of fallow. Hay and pasture crops, grasses, and grass-legume mixtures are dryfarmed in small areas of cropland. Corn for silage, sorghum, safflower, flax, mustard, and potatoes are other crops also grown on small acreages. The growing season ranges from 110 to 130 days, and the average annual precipitation ranges from 10 to 15 inches. The average annual air temperatures ranges from 41° to 43° F.

The crop-fallow system of rotation was initiated in the mid 1930's to reduce crop failure caused by drought. The main benefit attributed to fallowing has been weed control. Soil moisture research indicates that a very small amount of additional water is made available to crops as a result of fallowing. Research has also shown that extra moisture conserved through fallowing percolates below the root zone and adds to the water table. After a few years this extra water appears on the upper edge of low terraces as saline seep areas. Improved tillage equipment and chemicals have largely eliminated the need for fallowing to control weeds. Practices such as stubble-mulch tillage, contour farming, terracing, stripcropping, and growing tall wheatgrass conserve moisture, and when used with adequate fertilization, enable farmers to crop some soils more frequently than in an alternate crop-fallow system. This is particularly true of the level to gently undulating, deep, well drained soils that have moderate to moderately slow permeability and high available water capacity.

Soil blowing is a hazard throughout the county. Some soils are more susceptible than others, but all are susceptible to blowing if they are left bare. Stripcropping, stubble-mulch tillage (leaving crop residue on the surface), field windbreaks, and tall wheatgrass are used to control soil blowing. On some soils a single practice is effective, but on others, combinations of these practices are needed. Tillage operations that leave the surface ridged or rough also help to reduce soil blowing.

Runoff causes considerable erosion on much of the cropland. This is perhaps more apparent on the more steeply sloping soils. However, most damage occurs on gently sloping to strongly sloping soils where slopes are long. Some nearly level soils are severely damaged by scouring flows in meandering watercourses fed by runoff from nearby steeper slopes. Damaging runoff could be greatly reduced by contour stripcropping, terraces, and grassed waterways. Crop residue left on the surface also reduces damage caused by runoff.

Capability unit IIIe-2 (dryland)

This capability unit consists of deep, mainly well drained, nearly level to gently sloping and gently undulating soils. Slopes are dominantly 2 to 4 percent, but range from 0 to 4 percent. The surface layer is loam to silty clay loam, and the subsoil or underlying layer is loam to silty clay.

Permeability is moderate to moderately slow, and the available water capacity is high.

Runoff is very slow to medium, and the hazard of erosion is slight to moderate. The Havrelon soil in this unit is subject to local flooding during unusually warm periods in winter when ice jams form on the major streams.

The soils in this unit are suited to wheat, barley, oats,

corn for silage, and hay. Crops are dryfarmed in rotation with a season of fallow. Soil blowing is a hazard if fields are left bare for prolonged periods. Stripcropping, stubble-mulch tillage, field windbreaks, and tall wheatgrass help to reduce soil loss caused by soil blowing and to conserve moisture. They also trap drifting snow, thus increasing the available moisture. Contour farming, terraces, and grassed waterways also reduce soil loss caused by runoff. These practices can be effective if used either individually or together on these gently sloping soils.

Capability unit IIIe-4 (dryland)

This capability unit consists of deep, well drained, nearly level to sloping soils. Slopes are dominantly 2 to 4 percent, but range from 0 to 6 percent. The surface layer is fine sandy loam, and the subsoil or underlying layer is mostly sandy clay loam to fine sandy loam. The underlying material of some soils is loamy very fine sand.

Permeability is moderately slow to moderately rapid, and the available water capacity is moderate to high. Runoff is very slow to medium. The hazard of water erosion is slight to moderate, and the hazard of soil blowing is moderate to high. The Trembles soil in this unit is subject to local flooding during unusually warm winter months when ice jams form on the major streams.

The soils in this unit are suited to wheat, barley, oats, corn for silage, and hay. Crops are dryfarmed in rotation with a season of fallow because precipitation is limited. Stripcropping and stubble-mulch tillage are necessary to reduce soil loss caused by soil blowing. Deep tillage that leaves the surface rough helps control soil blowing when the surface is bare. Field windbreaks or tall wheatgrass barriers help to control soil blowing and to conserve moisture by trapping snow. Contour farming, terraces, and grassed waterways reduce soil loss caused by runoff. These practices should be used together for greatest effectiveness.

Capability unit IIIe-6 (dryland)

This capability unit consists of deep, well drained, gently sloping to sloping and undulating soils. Slopes are dominantly 4 to 8 percent, but range from 2 to 8 percent. The surface layer and subsoil or underlying layer are loam to silty clay loam.

Permeability is moderate to moderately slow, and the available water capacity is high. Runoff is medium to rapid, and the hazard of erosion is moderate to high.

The soils in this unit are suited to wheat, barley, oats, corn for silage, and hay. Crops are dryfarmed in rotation with a season of fallow because precipitation is limited. Soil blowing is a hazard when the surface is left bare for prolonged periods. Contour farming, stripcropping, leaving crop residue on the surface, and grassed waterways reduce soil loss caused by runoff and conserve moisture. These practices should be used together to achieve their maximum potential because of the slopes and runoff. Field windbreaks and tall wheatgrass barriers also help to control soil blowing and trap drifting snow.

Capability unit IIIs-2 (dryland)

This capability unit consists of deep, well drained and moderately well drained, nearly level and gently undulating soils. Slopes are 0 to 4 percent. The surface layer and subsoil or underlying layer are loam to silty clay. Layers of sand or of sand and gravel are at a depth of 10 to 40 inches, but mostly they are at a depth of 20 to 40 inches.

Permeability is moderate to slow in the upper part of the profile, and it is rapid to very rapid in the sandy or gravelly underlying material. The available water capacity is low to moderate. Runoff is very slow to slow, and the hazard of erosion is slight. Two soils in this unit, Ridgelawn and Hoffmanville soils, are subject to flooding during unusually warm winter months when ice jams form on the major streams.

The soils in this unit are suited to wheat, barley, oats, corn for silage, and hay. Crops are dryfarmed in rotation with a season of fallow because precipitation is limited. Crops are likely to fail if the precipitation is below average. Some soils are droughty and produce low yields in most years. Stripcropping, contour farming, and leaving crop residue on the surface help to conserve moisture and to reduce runoff. Field windbreaks and tall wheatgrass reduce soil blowing and trap drifting snow. Although the hazard of erosion is slight, measures must be taken to prevent excessive soil losses, which reduce the available water capacity and make the soils unsuitable for crops.

Capability unit IIIs-4 (dryland)

This capability unit consists of deep, mainly well drained, nearly level soils. Slopes are 0 to 2 percent. The surface layer and underlying layer are silty clay loam to clay.

Permeability is moderately slow to very slow, and the available water capacity is high. Runoff is very slow or slow, and the hazard of erosion is slight. One soil in this unit, the Lohler soil, is subject to local flooding during unusually warm winter months when ice jams form on the major streams.

The soils in this unit are suited to wheat, barley, oats, corn for silage, and hay. Crops are dryfarmed in rotation with a season of fallow because precipitation is limited. Contour farming, stripcropping, and leaving crop residue on the surface help to conserve moisture and to reduce soil loss caused by soil blowing. Field windbreaks and tall wheatgrass also help to control soil blowing and to trap drifting snow.

Capability units IIIc-2 (dryland)

This capability unit consists of deep, well drained, nearly level soils. Slopes are 0 to 2 percent. The surface layer is loam to silty clay loam, and the subsoil or underlying layer is loam to silty clay loam.

Permeability is moderate and moderately slow, and the available water capacity is high. Runoff is very slow

or slow, and the hazard of erosion is none or slight. The Havrelon soils in this unit are subject to local flooding during unusually warm months in winter when there are ice jams on the major streams.

The soils in this unit are suited to wheat, barley, oats, corn for silage, and hay. Crops are dryfarmed in rotation with a season of fallow because precipitation is limited. With added moisture, these soils could be cropped annually. Soil blowing is a hazard if fields are left bare for prolonged periods of time. Stripcropping, leaving crop residue on the surface, and planting field windbreaks and tall wheatgrass barriers help to reduce excessive soil loss caused by soil blowing and to conserve moisture. They also trap drifting snow, thus increasing the available moisture.

Capability unit IVe-2 (dryland)

This capability unit consists of deep, somewhat excessively drained, nearly level to gently sloping soils. Slopes are 0 to 4 percent. The surface layer is loamy fine sand, and the underlying layer is fine sandy loam to fine sand.

Permeability is rapid, and the available water capacity is moderate. Runoff is very slow, and the hazard of soil blowing is very high. Local areas are subject to flooding during unusually warm winter months when there are ice jams on the major streams.

The soils in this unit are not well suited to dryfarmed small grain or hay because precipitation is limited and the hazard of soil blowing is very high. If these soils are left bare for prolonged periods, soil losses are high and crops in adjacent fields can be damaged by the blowing soil. A permanent cover of grasses or legumes, grown for hay or pasture, is the best use for these soils. Contour farming, stripcropping, and leaving crop residue on the surface are necessary if small grain or row crops are grown. These practices minimize soil loss caused by soil blowing and help to conserve moisture. Field windbreaks and tall wheatgrass also reduce soil blowing and add to the limited moisture supply by trapping drifting snow.

Capability unit IVe-4 (dryland)

This capability unit consists mainly of deep, well drained, strongly sloping to rolling soils. Slopes range from 8 to 15 percent. The surface layer and subsoil or underlying layer are loam to clay loam.

Permeability is moderate and moderately slow, and the available water capacity is high. Runoff is medium or rapid, and the hazard of erosion is moderate or high.

The soils in this unit are suited to wheat, barley, oats, and hay. Crops are dryfarmed in rotation with a season of fallow because the precipitation is limited. However, effective erosion control measures are needed. Contour stripcropping, leaving crop residue on the surface, and grassed waterways are essential if the soils are cropped to small grain. Well-managed hay or pasture crops that form a sod will adequately reduce runoff and protect the soil from excessive erosion. Applications of barnyard manure or of nitrogen and phosphorus are beneficial in establishing and maintaining vigorous stands of hay and pasture crops.

Capability unit IVe-6 (dryland)

This capability unit consists of deep, well drained, sloping to rolling soils. Slopes are dominantly 4 to 8 percent, but range up to 12 percent. The surface layer, subsoil, and underlying material are fine sandy loam.

Permeability is moderately rapid, and the available water capacity is moderate. Runoff is slow or medium, and the hazard of erosion is moderate or high.

The soils in this unit are suited to wheat, barley, and oats. Crops are dryfarmed in rotation with a season of fallow because the precipitation is limited and the hazard of soil blowing is high. Stripcropping, field windbreaks, and leaving large amounts of crop residue on the surface are necessary to minimize losses caused by blowing and to conserve moisture. Permanent hay or pasture crops that provide a continuous cover afford the best protection and result in a minimum of soil loss caused by soil blowing and water erosion. Contour farming, terracing, and grassed waterways should also be used to reduce runoff and soil losses caused by water erosion. Some areas that were cropped have been seeded to native grass species and used as range.

Capability subclass VIe (dryland)

This capability subclass consists of mostly deep, somewhat excessively drained and well drained, nearly level to very steep soils. Some soils are moderately deep over bedrock and have a surface layer and underlying layer that are fine sandy loam to clay. However, the surface layer of other soils is loamy fine sand to gravelly loam or channery loam, and the underlying layer is loamy fine sand to very channery loam.

Permeability is very slow to rapid, and the available water capacity is very low to high. Runoff is very slow to very rapid, and the hazard of erosion is slight to very high.

The soils in this unit are not suited to cultivated crops because they have alkaline layers, a high hazard of soil blowing, or strongly sloping to very steep slopes. For range site descriptions and management needs of these soils, see the section, "Range."

Capability subclass VIw (dryland)

This capability subclass consists of deep, poorly drained to well drained, nearly level to gently sloping soils. Some soils are strongly affected by salt and alkali. The surface layer and underlying layer are fine sandy loam to clay. Some soils have a water table that rises to within a few inches of the surface during the growing season. Permeability is high. Runoff is slow or ponded, and the hazard of erosion is none to high.

The soils in this unit are not suited to cultivated crops because of periodic flooding, high erosion hazard, high water table, alkali layers, or salinity. For range site descriptions and management needs of these soils see the section, "Range."

Capability subclass VIIs (dryland)

This capability subclass consists of deep, excessively drained, moderately steep to very steep soils. The surface layer is gravelly sandy loam, and the underlying layer is gravelly sand and very gravelly sand.

Permeability is rapid, and the available water capacity is very low. Runoff is very slow or slow, and the hazard of erosion is moderate. The soil blowing hazard is moderate. Terrace escarpments in areas of these soils are used and managed along with them.

The soils in this unit are too steep and droughty to be used for dryfarmed crops. They have limited use as range. For specific management, refer to Gravel range site in the section, "Range."

Capability subclass VIIIe (dryland)

This capability subclass consists of the miscellaneous area, Badland, and has little or no development. Badland consists of steep to very steep, severely eroded and broken slopes formed by down-cutting into the soft sandy, silty, and clayey sedimentary rock.

Capability subclass VIIIw (dryland)

This capability subclass consists of the miscellaneous area, Riverwash, and has little or no development. Riverwash consists of sand and gravel bars along major streams that are subject to annual flooding. Some areas support moderate stands of brush vegetation, mainly willows, that provide some browse and cover for wildlife but have no practical grazing value for domestic livestock.

Irrigation management

Irrigated crops are grown on about 46,301 acres in Richland County. Sugar beets, alfalfa grown for hay, corn grown for silage, and dry beans are the main crops. A small acreage of barley and oats and a few areas of pasture are irrigated. There are 110 to 130 frost-free days.

Water is diverted and pumped from the Yellowstone River and delivered by a system of relief pumps, canals, and ditches. It is then applied to crops by either border or furrow methods. A few private systems pump water from the Missouri River.

Irrigation efficiency is generally low. This could be improved by lining canals and ditches; installing adequate control structures; land leveling; and using furrows, borders, contour levees, and contour ditches. Some areas could be irrigated more efficiently with sprinkler systems.

Soil blowing is a hazard on most of the irrigated cropland if fields are left bare during fall and winter. In fall when crops are harvested and fields are plowed, leaving crop residue on the surface and leaving the surface rough help to control soil blowing. Field windbreaks are also effective.

Capability unit IIe-1 (irrigated)

This capability unit consists of deep, well drained, nearly level to gently sloping soils. Slopes are dominantly 2 to 4 percent, but range from 1 to 4 percent. The surface layer is loamy to silty clay loam, and the subsoil or underlying layer is loam to silty clay.

Permeability is moderate and moderately slow, and the available water capacity is high. Runoff is very slow to medium, and the hazard of erosion is slight or moderate. The Havrelon soil in this unit is subject to local flooding during unusually warm winter months when there are ice jams on the streams.

The soils in this unit are suited to pasture, alfalfa, corn grown for silage, sugar beets, dry beans, barley, and oats. Soil blowing is a moderate hazard if fields are left bare for prolonged periods. It can be effectively controlled by leaving crop residue on the surface or by using field windbreaks. Irrigation is applied by furrow and border methods. Contour farming of row crops reduces erosion caused by runoff. Water distribution can be improved by land leveling. Bench leveling can be done in most places without permanently damaging the soils by deep cutting. Leveling of large areas using deep cutting can expose strongly alkaline, strongly saline, or sandy layers in some places. Applications of barnyard manure and of nitrogen, or phosphorus, or both, are beneficial to crop establishment and plant vigor, especially where limy substrata are exposed by leveling.

Capability unit IIe-3 (irrigated)

This capability unit consists of deep, well drained, nearly level soils. Slopes are 0 to 2 percent. The surface layer, subsoil, and underlying layer are fine sandy loam.

Permeability is moderately rapid, and the available water capacity is moderate. Runoff is very slow to slow, and the hazard of erosion is slight or moderate.

The soils in this unit are suited to pasture, alfalfa, corn grown for silage, sugar beets, dry beans, barley, and oats. The hazard of soil blowing is moderate or high if fields are left bare for prolonged periods of time. Using field windbreaks, leaving crop residue on the surface, and leaving the surface roughened by tillage are effective in reducing soil blowing. Deep cutting when leveling does not permanently damage these soils. Applications of barnyard manure and of nitrogen or phosphorus, or both, are beneficial to crop establishment and plant vigor. If irrigation runs are long, deep percolation results in water loss. Concrete-lined ditches help reduce seepage losses and make ditch maintenance easier. These soils can be irrigated by the sprinkler, border, or furrow methods.

Capability unit IIs-1 (irrigated)

This capability unit consists of deep, well drained, nearly level soils. Slopes range from 0 to 1 percent. The surface layer is loam to silty clay. Loamy fine sand or fine sand with 0 to 50 percent gravel is at a depth of 20 to 40 inches.

Permeability is moderate to slow in the surface layer and rapid in the underlying material. Available water capacity is moderate. Runoff is very slow or slow, and the hazard of erosion is slight. Two soils in this unit, Ridgelawn and Hoffmanville soils, are subject to local flooding during unusually warm winter months when ice jams form on the streams.

The soils in this unit are suited to pasture, alfalfa, corn grown for silage, dry beans, sugar beets, barley, and oats. Leveling improves water distribution where the surface layer is uneven, but deep cuts reduce the available water capacity and expose the sandy sub-

strata. Cuts should be kept to less than 1 foot if possible. Water loss is high if ditches are cut into the sandy substrata. Concrete-lined ditches help prevent high seepage losses and make ditch maintenance easier. Applications of barnyard manure and of nitrogen or phosphorus, or both, are beneficial to crop establishment and plant vigor, especially if limy substrata are exposed by leveling.

Capability unit IIs-3 (irrigated)

This capability unit consists of deep, moderately well drained, nearly level soils. Slopes are 0 to 2 percent. The surface layer and underlying layer are clay and silty clay loam. The effective root depth is 5 feet or more.

Permeability is moderately slow to very slow, and the available water capacity is high. Runoff is very slow or slow, and the hazard of erosion is none or slight. The Lohler soils are subject to local flooding during unusually warm winter months when there are ice jams in the major streams.

The soils in this unit are suited to pasture, alfalfa, corn grown for silage, dry beans, sugar beets, barley, and oats. A slow water intake rate makes these soils difficult to irrigate. Water distribution can be improved by leveling where the surface is uneven. Deep cutting during leveling exposes moderately alkaline to strongly alkaline layers that form crusts and further reduce water intake. Soil blowing is a hazard if fields are left bare for prolonged periods. Using field windbreaks, leaving crop residue on the surface, and leaving the surface roughened by tillage are effective ways to control blowing. Applications of barnyard manure and of nitrogen or phosphorus, or both, are beneficial to crop establishment and to plant vigor, especially in cut areas.

Capability unit IIc-1 (irrigated)

This capability unit consists of deep, well drained, nearly level soils. Slopes range from 0 to 2 percent. The surface layer is loam to silty clay loam, and the subsoil or underlying layer is loam to silty clay.

Permeability is moderate and moderately slow, and the available water capacity is high. Runoff is very slow to slow, and the hazard of erosion is none to slight. The Havrelon soils are subject to local flooding during unusually warm winter months when ice jams form on the major streams.

The growing season of 110 to 130 days is the only limitation to use of these soils. It restricts the number of crops that can be grown to frost-tolerant species or short-season maturing hybrids. The soils in this unit are suited to pasture, alfalfa, corn grown for silage, dry beans, sugar beets, barley, and oats. Water is applied to row crops by the furrow method and to small grain or hay crops by the border method. Water distribution can be improved by land leveling where the surface is uneven. These soils are permanently damaged by deep cutting when leveling. Applications of barnyard manure, and nitrogen or phosphorus, or both, are beneficial for crop establishment and for plant vigor, especially where a limy subsurface layer is exposed by leveling.

Capability unit IIIe-1 (irrigated)

This capability unit consists of deep, well drained, sloping soils. Slopes range from 4 to 8 percent. The surface layer, subsoil, and underlying layer are silty clay loam to loam.

Permeability is moderately slow or moderate, and the available water capacity is high. The effective rooting depth is 5 feet or more. Runoff is medium, and the hazard of erosion is moderate.

The soils in this unit are used mainly for alfalfa and corn grown for silage. They are difficult to irrigate without causing erosion. Contour irrigation of row crops helps reduce erosion caused by runoff. Hay crops can be irrigated safely from contour ditches if borders are narrow and runs are short. Corrugations within the borders can be used to establish crops. Some limited leveling or smoothing to remove local high and low spots will make irrigation easier. Applications of barnyard manure and of nitrogen or phosphorus, or both, are beneficial to crop establishment and plant vigor in these areas.

Capability unit IIIe-3 (irrigated)

This capability unit consists of deep, well drained, nearly level to gently sloping soils. Slopes range from 0 to 4 percent. These soils are fine sandy loam to a depth of 40 inches or more. Loamy fine sand strata occur at a depth of 40 inches and more in some places.

Permeability is moderately rapid, and the available water capacity is moderate. Runoff is very slow or slow. The hazard of water erosion is moderate, and the hazard of soil blowing is moderate or high. The Trembles soil is subject to local flooding during unusually warm winter months when there are ice jams in the major streams.

The soils in this unit are suited to pasture, alfalfa, corn grown for silage, sugar beets, dry beans, barley, and oats. Using field windbreaks, leaving crop residue on the surface, and leaving the surface roughened by tillage are effective ways to control soil blowing. Deep cutting when leveling does not damage this soil. Applications of barnyard manure and of nitrogen or phosphorus, or both, are beneficial to crop establishment and to plant vigor after leveling. This soil can be irrigated with sprinkler systems, or by border and furrow methods. Furrows should be placed on the contour in the steeper areas. Deep percolation results in water loss if irrigation runs are long. Concrete-lined ditches help reduce seepage losses and make ditch maintenance easier.

Capability unit IIIe-5 (irrigated)

This capability unit consists of deep, well drained, nearly level to gently undulating soils. Slopes are dominantly 2 to 4 percent, but range from 0 to 4 percent. The surface layer is loam to clay loam, and the subsoil is gravelly loam to gravelly clay loam and clay loam. Gravelly sand or very gravelly loamy sand is at

a depth of 10 inches in some places, but mostly it is at a depth of 20 to 40 inches.

Permeability is slow to moderate in the surface layer and subsoil, and it is rapid or very rapid in the underlying material. The available water capacity is low to moderate. Runoff is slow, and the hazard of erosion is slight.

The soils in this unit are used for pasture, alfalfa, corn grown for silage, sugar beets, dry beans, barley, and oats. Irrigation is difficult because the rate of water intake and available water capacity vary considerably. Leveling to improve water distribution exposes sandy or gravelly substrata in the Beaverton soils, and this makes them more difficult to irrigate and creates a hazard of soil blowing. Care must be taken when designing an irrigation system for these soils to prevent excessive water loss and erosion. If excessive cutting is needed in conveyance and field ditches as a result of slopes, the underlying sand and gravel will be exposed and water losses will be great.

Capability IVe-1 (irrigated)

This unit consists of deep, somewhat excessively drained, nearly level to gently sloping soils. Slopes are 0 to 4 percent. The surface layer is loamy fine sand, and the underlying layer is fine sandy loam to fine sand.

Permeability is rapid, and the available water capacity is moderate. Runoff is very slow, and the hazard of soil blowing is very high. Some soils are subject to local flooding during unusually warm winter months when ice jams form in the major streams.

The soils in this unit are used for pasture, alfalfa, sugar beets, corn grown for silage, barley, and oats. The hazard of soil blowing is very high if the fields are left bare for prolonged periods of time. Some crop damage can be expected in spring when seedlings are emerging unless the fields are protected from soil blowing. Using field windbreaks and leaving large amounts of crop residue on the surface help reduce or control soil blowing. Irrigation by furrow and border methods is difficult because the soils have rapid permeability. Keeping runs short helps reduce excessive water loss by deep percolation. Concrete-lined ditches reduce seepage losses. More even water distribution is obtained by using sprinkler systems. Applications of barnyard manure and of nitrogen or phosphorus, or both, are beneficial to crop establishment and to plant vigor, especially after leveling.

Windbreaks

Windbreaks are narrow belts of trees and shrubs used mainly to protect farmsteads and feedlots from wind and snow. A good windbreak provides protection, makes a homesite more attractive, and furnishes food and cover for birds and other wildlife. It also reduces noise from roads and railroads and screens unsightly areas. Most windbreaks in Richland County consist of 3- to 7-row belts on the windward side of farmsteads and feedlots, and single-row plantings across fields to protect cropland from soil blowing.

Windbreaks should be planted in rows running at right angles to the prevailing wind and as nearly as possible on the contour. Where plantings are on slopes that would create a hazard of erosion, special measures, such as diversion terraces and cross drains, are needed to control runoff. Sites should be fallowed before planting to eliminate weeds and grass and to prepare a suitable seedbed. On dryland sites, continuous cultivation between the rows and along the outside rows will be needed for the life of the windbreak. Preemergence herbicides help control weeds within tree rows. Grazing livestock are injurious to trees at any age and must be excluded. Tree rows should be at least 100 feet from buildings, feedlots, and roads to reduce the possibility of snowdrifts forming in areas where protection is desired.

A variety of species is used in windbreaks in the area. Caragana (Siberian peashrub), Tatarian honeysuckle, Nanking cherry, and common lilac are examples of commonly used shrubs. Russian-olive, American plum, and Siberian crabapple are examples of adapted low trees. Siberian elm is a medium height tree commonly used in dryland plantings. Cottonwood, golden willow, and white willow are tall trees that are well suited to irrigated sites and to areas that receive extra moisture from runoff. Ponderosa pine, Colorado blue spruce, and Rocky Mountain juniper are used in some windbreaks.

Most of the soils that are suitable for growing crops are also suitable for windbreaks. Deep, friable, well drained soils that have slopes of less than 15 percent are the most suitable. These include Bowbells, Farnuf, Savage, Shambo, Tally, Turner, Vida, and Williams soils.

Deep, well drained soils on stream terraces and flood plains are well suited to windbreaks. They receive runoff and support native stands of cottonwood, ash, and willow. These include Cherry, Havrelon, Hoffmanville, Lohler, Ridgelawn, and Trembles soils.

Soils that have low to moderate available water capacity and sandy profiles are suited to dryland plantings. Plantings are expected to grow more slowly than on wetter soils, and there is a hazard of soil blowing which could damage young plants. Banks, Blanchard, Dast, and Lihen soils are in this group. Irrigation water is available in many areas of Banks soils.

The Lambert and Zahill soils are strongly calcareous. Plantings have a slower rate of growth on these soils.

Beaverton soils have a loamy surface layer and subsoil. Sand and gravel are at a depth of 10 to 20 inches and give these soils low available water capacity. Species that are not drought-tolerant do not grow well on these soils unless irrigated.

Deep, clayey Lohler and Marias soils have slow and very slow permeability. Maximum spacing between plants and rows is necessary for adequate moisture to reach the underlying layer.

The strongly alkaline Adger, Benz, and Vanda soils are the least desirable for windbreaks. If it is necessary to plant on these soils, alkali- and salt-tolerant species, such as Russian-olive, Rocky Mountain juniper, and buffaloberry, should be used.

Soils that are not mentioned have slopes of more

than 15 percent or they have other undesirable features, such as salinity, a high water table, or annual flooding.

Range

Fifty-four percent of Richland County is rangeland, 93 percent of which is privately owned. The livestock industry is predominantly beef, both cow-calf and feeder operations. There are approximately 65,000 cattle and 16,000 sheep in the county. The vegetation consists of mid and tall grasses and forbs and shrubs. Raising cattle and sheep are the main livestock enterprises.

The soils of the survey area have been grouped into range sites. Information on suitable plant species and production yields in favorable and unfavorable years is provided for each group.

Range sites and condition classes

Soils that have the capacity to produce the same kind, amount, and proportion of range plants are grouped into range sites. A range site is the product of all the environmental factors that affect its development.

The plant community in a range site that has not undergone abnormal disturbance is the potential, or climax, plant community for that site. The composition of climax plant communities is not precise or fixed but varies within reasonable limits from year to year and from place to place.

Abnormal disturbances, including overuse by livestock, excessive burning, erosion, and plowing, change the climax plant community or destroy it completely if the disturbances are drastic. If the range site has not deteriorated significantly under such disturbances, secondary plant succession progresses in the direction of the natural potential or climax plant community for the site.

There are four range condition classes that indicate the degree of departure from the potential, or climax, vegetation. The classes show the present condition of the native vegetation on a range site in relation to the native vegetation that could grow there.

A range site is in excellent condition if 76 to 100 percent of the vegetation is of the same kind as that in the climax stand. It is in good condition if the percentage is 51 to 75; in fair condition if the percentage is 26 to 50; and in poor condition if the percentage is less than 25.

If the climax plant community is changed by livestock grazing or other disturbance, some plant species will increase and others will decrease. Whether a species increases or decreases depends on the grazing animal, the season of use, and the degree of use. By comparing the composition of the present plant community to the potential plant community, it is evident how individual species have increased while others have decreased. Plants that are not included in the climax community but that are found in the present plant community are invaders of the site.

Data about the composition of climax and present plant communities, and other range site information provide the basis for selecting management systems for ranges.

Objectives of range management are generally to increase desirable plants and restore the plant community to as near climax conditions as possible. Some programs are designed to establish or maintain a plant community that differs from the climax to fit specific needs in the grazing program, for example, to provide wildlife habitat. All management objectives should be compatible with conservation objectives.

The range sites in Richland County are briefly described in the following pages, and the climax plants and principal invaders on the sites are named. The estimate of the potential annual yield is expressed in terms of excellent condition, unless indicated otherwise, for favorable and unfavorable years. Yields are given as the normal, high, and low rather than the extreme. The yields are the total for the year, in pounds, of air-dry herbage per acre and include the current year's growth of leaves, stems, twigs, and fruits of all plants on the site. Not all of this herbage is usable by livestock. The "Guide to mapping units" at the back of this soil survey gives the site in which each soil has been placed.

Wetland range site

This range site consists only of Lohler clay, wet. This is a deep, moderately well drained, nearly level soil. The surface layer and underlying layer are clay. The seasonally high water table rises to within a few inches of the surface during the growing season. Runoff is very slow or ponded, and the hazard of erosion is none or slight.

This site is not extensive and makes up about 0.1 percent of the rangeland in the survey area. The vegetation on this site is about 80 percent grass, 10 percent forbs, and 5 percent shrubs. Approximate species composition (by air-dry weight) of the potential plant community is prairie cordgrass, 50 percent; bluejoint reedgrass, 10 percent; sloughgrass, 10 percent; big bluestem, 5 percent; northern mannagrass, 5 percent; Reed canarygrass, 5 percent; perennial forbs, 10 percent; woody plants, 5 percent.

If this range site is in excellent condition, the estimated total annual production of all plant species is about 5,600 pounds (air-dry) per acre in favorable years and about 1,500 pounds per acre in unfavorable years. Approximately 90 percent of this production is plants that furnish forage for cattle, sheep, deer, and antelope. This production of forage for grazing animals should not be construed as the proper intensity of grazing management for this or any of the following range sites.

Under continued heavy grazing, prairie cordgrass, bluejoint reedgrass, and tall sedges are replaced by forb and sedge increasers.

Proper grazing management and planned grazing systems bring about rapid recovery of this site if it has an adequate amount of desirable forage plants.

This site is not well suited to mechanical improvement because of wetness.

Saline Lowlands range site

This range site consists of Typic Haplaquents. These are deep, poorly drained, saline, nearly level loamy soils on stream terraces and flood plains. These soils are strongly alkali and saline. The soil surface between plants has a white crust of salts in many places. A water table is at or within a few inches of the surface during the growing season. Areas of the Fox Lake Waterfowl Refuge that are not continuously under water are in this range site.

This site makes up about 2.6 percent of the rangeland in the survey area. The vegetation on this site is nearly 100 percent grasses and grasslike plants with some scattered shrubs and forbs. Approximate species composition (by air-dry weight) of the potential plant community is alkali sacaton, 40 percent; western wheatgrass, 15 percent; saltgrass, 10 percent; alkali cordgrass, 10 percent; alkaligrass, 5 percent; slender wheatgrass, 5 percent; Montana wheatgrass, 5 percent; squirreltail, 5 percent; and sedges, 5 percent.

If this range site is in excellent condition, the estimated total annual production of all plant species is about 2,200 pounds (air-dry) per acre in favorable years and about 600 pounds per acre in unfavorable years. About 95 percent of this production is from plants that furnish forage for cattle, sheep, deer, and antelope.

Under continued heavy grazing, alkali sacaton and western wheatgrass decrease and are replaced by saltgrass, mat muhly, foxtail barley, curlycup gumweed, tumblegrass, rushes, and annual plants.

Proper grazing management and planned grazing systems generally bring about rapid recovery of this site if it has an adequate amount of desirable grasses. These areas are not suited to mechanical improvement.

Overflow range site

This range site consists only of Cherry, Havrelon, and Trembles soils, occasionally flooded. These are nearly level and gently sloping soils on low terraces and flood plains in narrow valleys of intermittent streams. These soils are subject to periodic damaging overflow. Slopes are commonly less than 4 percent, but the site includes short, steep terrace breaks and meandering stream channels. Runoff is slow, but the hazard of erosion is high because the streams overflow. Areas of rangeland that are part of dike systems designed to spread diverted streamflow are also in this range site.

This site makes up about 4 percent of the rangeland in the survey area, but because of its favorable moisture conditions, it produces more grazable forage per acre than most other range sites. The vegetation on this site is about 85 percent grasses, 10 percent shrubs, and 5 percent forbs. Approximate species composition (by air-dry weight) of the potential plant community is western wheatgrass and thickspike wheatgrasses, 30 percent; green needlegrass, 15 percent; needleandthread, 5 percent; big bluestem, 5 percent; little bluestem, 5 percent; slender wheatgrass, 5 percent; other tall grasses, 20 percent; woody plants, 10 percent; and perennial forbs, 5 percent.

If this range site is in excellent condition, the estimated total annual production of all plant species is about 2,500 pounds (air-dry) per acre in favorable years and about 1,500 pounds per acre in unfavorable years. About 85 percent of this production is from plants that furnish forage for cattle, sheep, deer, and antelope.

Under continued heavy grazing, green needlegrass, needleandthread, western wheatgrass, thickspike wheatgrass, and other tall grasses are replaced by increased amounts of silver sagebrush, Kentucky bluegrass, Canada bluegrass, smooth brome, tumblegrass, and annual plants.

Proper grazing management and planned grazing systems generally bring about rapid recovery of this site if the site has an adequate amount of desirable plants. Response is slow where the dominant plant cover is Kentucky bluegrass or smooth brome. Brush management is beneficial in small areas where silver sagebrush, snowberry, or rosebush is the dominant plant cover. Most of this site is not suitable for mechanical improvement because the hazard of erosion is high if the plant cover is destroyed.

It is difficult to balance grazing of this site with the grazing of adjacent sites because of the shade, shelter, longer green grass period, and available water that this site provides. On large tracts, fencing facilitates grazing management.

Sands range site

This range site consists of deep, somewhat excessively drained, nearly level to gently sloping soils on stream terraces and flood plains; and deep, well drained and excessively drained, sloping to steep soils on uplands. The surface layer is loamy fine sand, and the underlying layer is fine sandy loam to fine sand. Permeability is rapid, and the available water capacity is low to moderate. Gentle rains are highly effective because runoff is very slow to medium. The hazard of soil blowing is high to very high when cover is inadequate.

A few areas are larger than 100 acres. This range site makes up about 1.6 percent of the rangeland in the survey area. The vegetation on this site is about 85 percent grasses and sedges, 10 percent shrubs, and 5 percent forbs. Approximate species composition (by air-dry weight) of the potential plant community is prairie sandreed, 30 percent; little bluestem, 28 percent; sand bluestem, 10 percent; big bluestem, 5 percent; needleandthread, 5 percent; western wheatgrass, 2 percent; woody plants, 10 percent; upland sedges, 5 percent; and perennial forbs, 5 percent.

If this range site is in excellent condition, the estimated total annual production of all plant species is about 1,800 pounds (air-dry) per acre in favorable years and about 1,000 pounds per acre in unfavorable years. About 90 percent of this production is from plants that furnish forage for cattle, sheep, deer, and antelope.

Under continued heavy grazing, prairie sandreed, little bluestem, sand bluestem, and big bluestem are replaced by increased amounts of needleandthread, western wheatgrass, sedges, and large amounts of forbs and annual grasses.

Response to proper grazing management and planned grazing systems is generally good on this site. Mechanical improvement that disturbs the surface or leaves it bare should be avoided because of the hazard of soil blowing.

Sandy range site

This range site consists of deep, well drained, nearly level soils on terraces and flood plains and deep, well drained, nearly level to moderately steep soils on uplands. Some upland soils are moderately deep. The surface layer is fine sandy loam, and the underlying layer is loamy fine sand to clay loam. Permeability is moderately slow to moderately rapid, and the available water capacity is moderate to high. Runoff is very slow to medium, and the hazard of soil blowing is moderate to very high.

This site makes up about 1.9 percent of the rangeland in the survey area. The vegetation on this site is generally about 90 to 95 percent grasses, 5 to 10 percent shrubs, and some forbs. Approximate species composition (by air-dry weight) of the potential plant community is little bluestem, 20 percent; needleandthread, 20 percent; prairie sandreed, 15 percent; western wheatgrass, 15 percent; sand bluestem, 5 percent; sand dropseed, 3 percent; sideoats grama, 2 percent; other tall grasses, 5 percent; short grasses, 8 percent; and woody plants, 7 percent.

If this range site is in excellent condition, the estimated total annual production of all plant species is about 1,600 pounds (air-dry) per acre in favorable years and about 900 pounds per acre in unfavorable years. Approximately 90 percent of this production is from plants that furnish forage for cattle, sheep, deer, and antelope.

Under continued heavy grazing, bluestems, needleandthread, prairie sandreed, sideoats grama, and other high-producing grasses are replaced by upland sedges, green sagewort, tumblegrass, annual grasses, and forbs. Small, low terrace areas support fair stands of woody plants, such as rosebush, snowberry, chokecherry, silver sagebrush, and buffaloberry.

Response to planned grazing systems and proper grazing management is generally good on this site. In areas where the more desirable plants are nearly or completely grazed out, site recovery is very slow. Nearly level areas of this site are suited to most mechanical improvements. Shallow chiseling or range pitting generally brings good response if there is an adequate amount of desirable grasses. A complete seedbed preparation followed by range seeding can be used to reestablish some areas. Brush management can be advantageous on some bottom lands where woody plants have increased to dominate the plant cover.

Silty range site

This range site consists of deep, well drained, nearly level to strongly sloping and rolling soils on flood plains, terraces, and sedimentary and glaciated uplands. The surface layer is loam to silty clay loam, and the underlying layers are mostly loam to silty clay loam. In some areas, the underlying material is fine sand to silty clay loam. In some areas, the underlying material is fine sand to very gravelly clay loam that begins at a depth of 20 to 40 inches. Permeability is mostly moderate to moderately slow, but it is rapid in some soils. The available water capacity is mostly high, but ranges to moderate. Runoff is very slow to rapid, and the hazard of erosion is slight to high.

This site occurs in large tracts and makes up about 32 percent of the rangeland in the survey area. The vegetation on this site generally is about 90 percent grasses, 5 percent shrubs, and 5 percent forbs. Approximate species composition (by air-dry weight) of the potential plant community is western thickspike wheatgrasses, 45 percent; needleandthread, 20 percent; green needlegrass, 5 percent; little bluestem, 5 percent; prairie sandreed, 5 percent; blue grama, 5 percent; winterfat, 3 percent; short grasses, 7 percent; perennial forbs, 3 percent; and sagebrush and sageworts, 2 percent.

If this range site is in excellent condition, the estimated total annual production of all plant species is about 1,500 pounds (air-dry) per acre in favorable years and about 800 pounds per acre in unfavorable years. Approximately 95 percent of this production is from plants that furnish forage to cattle, sheep, deer, and antelope.

Under continued heavy grazing, the wheatgrasses, green needlegrass, needleandthread, little bluestem, prairie sandreed, and winterfat are replaced by increased amounts of short grasses, unpalatable forbs, club moss, and woody plants. Small areas of nearly level soils in this range site along the streams support fair stands of brushy plants, such as chokecherry, rosebush, snowberry, buffaloberry, and silver sagebrush.

This range site is easily overused, because it is easily accessible and readily grazed by livestock any time of the year.

Response to proper grazing management and planned grazing systems is good on this site. Recovery is very slow in areas where the desirable grasses are nearly or completely grazed out. Most of this site is suited to mechanical improvement. Shallow chiseling, range pitting, or contour furrowing followed by deferred grazing brings good response if there is an adequate amount of desirable grasses. A program for weed control may be needed if significant amounts of fringed sagewort, broom snakeweed, and other weedy plants have increased but there are still adequate amounts of desirable plants. A complete seedbed preparation followed by range seeding and deferred grazing may be needed to reestablish desirable cover in some areas in poor range condition. Brush management can be advantageous in small areas where silver

sagebrush, rosebush, snowberry, or other woody plants have increased to dominate the plant cover.

Clayey range site

This range site consists of deep, mostly well drained, nearly level to gently sloping soils on alluvial fans and terraces. Some soils are moderately well drained. The surface layer is silty clay to silty clay loam, and the underlying layers are loam to silty clay. Permeability is mostly very slow to moderate, but it is rapid in some soils below a depth of 20 to 40 inches. Runoff is very slow to medium, and the available water capacity is moderate to high. The hazard of erosion is slight to moderate.

This site is not extensive and makes up about 2.8 percent of the rangeland in the survey area. The vegetation on this site is generally about 85 to 90 percent grasses, 5 percent shrubs, and 5 to 10 percent forbs. Approximate species composition (by air-dry weight) of the potential plant community is western and thickspike wheatgrasses, 60 percent; green needlegrass, 18 percent; blue grama, 5 percent; perennial forbs, 7 percent; big sagebrush, 5 percent; and short grasses, 5 percent.

If this range site is in excellent condition, the estimated total annual production of all plant species is about 1,300 pounds (air-dry) per acre in favorable years and about 800 pounds per acre in unfavorable years. Approximately 95 percent of this production is from plants that furnish forage for cattle, sheep, deer, and antelope.

Under continued heavy grazing, the wheatgrasses and green needlegrass decrease, and blue grama, perennial forbs, other short grasses, and sagebrush increase.

Response to proper grazing management and planned grazing systems is generally good on this site. This site is suited to mechanical treatment. Shallow chiseling, range pitting, contour furrowing, and range seeding, where needed, generally have satisfactory results if followed by proper grazing management.

Thin Hilly range site

This range site consists of deep, well drained, hilly to very steep soils on uplands. The surface layer and underlying layers are mostly loam to silty clay loam. Some soils have a gravelly loam surface layer. Permeability is slow to moderately slow, and the available water capacity is high. Runoff is rapid to very rapid, and the hazard of erosion is high. Small areas of eroded soils are common.

This site is the most extensive in the survey area and makes up about 50 percent of the rangeland. The vegetation on this site is generally about 75 to 85 percent tall and mid grasses, 10 percent short grasses, 5 percent shrubs, and 5 percent forbs. Approximate species composition (by air-dry weight) of the potential plant community is little bluestem, 20 percent; western and thickspike wheatgrasses, 20 percent; prairie sandreed, 10 percent; needleandthread, 10 percent; green needlegrass, 5 percent; plains muhly, 4 percent; bluebunch wheatgrass, 4 percent; sideoats grama, 2 percent; short grasses, 10 percent; sedges, 5 percent; perennial forbs, 5 percent; and woody plants, 5 percent.

If this range site is in excellent condition, the estimated total annual production of all plant species is about 1,200 pounds (air-dry) per acre in favorable years and about 600 pounds per acre in unfavorable years. About 95 percent of this production is from plants that furnish forage for cattle, sheep, deer, and antelope.

Under continued heavy grazing, little bluestem, the wheatgrasses, prairie sandreed, and green needlegrass are replaced by short grasses, sedges, perennial forbs, broom snakeweed, fringed sagewort, curlycup gumweed, and annuals.

Response to proper grazing management and planned grazing systems is good on this site. Generally, this site is not suited to any mechanical improvement because the slopes are steep and the hazard of erosion is high.

Shallow to Gravel range site

Only the Beaverton part of Turner-Beaverton complex, 0 to 4 percent slopes, is in this range site. It is a deep, well drained, nearly level to gently sloping soil on terraces and uplands. The surface layer is loam, and the subsoil is clay loam in the upper part and gravelly loam in the lower part. Gravel and sand are at a depth of 10 to 20 inches. Permeability is moderate in the surface layer and in the subsoil, and it is very rapid in the underlying layer. The available water capacity is low. Runoff is slow, and the hazard of erosion is slight.

This site makes up about 0.7 percent of the rangeland in the survey area. The vegetation on this site is generally about 90 to 95 percent grasses, 5 to 10 percent forbs, and some scattered brush. Approximate species composition (by air-dry weight) of the potential plant community is needleandthread, 25 percent; western wheatgrass and thickspike wheatgrass, 20 percent; little bluestem, 10 percent; bluebunch wheatgrass, 8 percent; plains muhly, 8 percent; prairie sandreed, 5 percent; sand dropseed, 5 percent; sideoats grama, 2 percent; short grasses, 10 percent; and perennial forbs, 7 percent.

If this range site is in excellent condition, the estimated total annual production of all plant species is about 800 pounds (air-dry) per acre in favorable years and about 400 pounds per acre in unfavorable years. About 95 percent of this production is from plants that furnish forage for cattle, sheep, deer, and antelope.

Under continued heavy grazing, needleandthread, the wheatgrasses, and little bluestem are replaced by increased amounts of upland sedges, blue grama, Sandberg bluegrass, red threeawn, hairy goldaster, and annual forbs.

Areas of this range site are easily reached and readily grazed by livestock. During most winters, the snow cover is light and exposes the plants to heavy use.

This site responds moderately well to proper grazing management and planned grazing systems. It is suited to mechanical improvement, such as range pitting or shallow chiseling. It is also suited to range seeding.

Dense Clay range site

This range site consists of deep, well drained to moderately well drained, nearly level soils on alluvial fans and low terraces along the Yellowstone and Missouri Rivers and deep, well drained, nearly level to moderately sloping soils on uplands. The surface layer and underlying layer are silty clay loam to clay. The Vanda soil is strongly alkaline to very strongly alkaline at or near the surface. Permeability is very slow to moderately slow, and the available water capacity is moderate to high. Runoff is very slow to medium, and the hazard of erosion is none to high.

Areas of this site are small and make up about 0.4 percent of the rangeland in the survey area. The vegetation on this site is generally about 90 percent grasses and 10 percent shrubs and some scattered forbs. Approximate species composition (by air-dry weight) of the potential plant community is western and thickspike wheatgrasses, 80 percent; perennial forbs, 5 percent; short grasses, 5 percent; saltgrass, 3 percent; squirreltail, 2 percent; greasewood, 3 percent; and sagebrush, 2 percent.

If this range site is in excellent condition, the estimated total annual production of all plant species is about 800 pounds (air-dry) per acre in favorable years and about 400 pounds per acre in unfavorable years. Approximately 90 percent of this production is from plants that furnish forage for cattle, sheep, deer, and antelope.

Under continued heavy grazing, western wheatgrass and thickspike wheatgrass are replaced by buffalobur, foxtail barley, tumblegrass, curlycup gumweed, pricklypear cactus, false buffalograss, and annual plants.

Response to proper grazing management and grazing systems is slow on this site. This site is not well suited to mechanical improvement. Shallow chiseling can temporarily increase production by increasing the infiltration rate.

Gravel range site

This range site consists of Tinsley soils, 15 to 65 percent slopes. These are deep, excessively drained, moderately steep to very steep soils on uplands. The surface layer is gravelly sandy loam and gravelly loamy sand, and the underlying layers are gravelly sand and very gravelly sand. Permeability is rapid, and the available water capacity is very low. Most of the water is lost through deep percolation. Runoff is very slow to slow, and the hazard of erosion is moderate.

This site makes up about 2.7 percent of the rangeland in the survey area. The vegetation on this site is generally 80 to 85 percent grasses and grasslike plants, 15 percent forbs, and small amounts of brush. Approximate species composition (by air-dry weight) of the potential plant community is plains muhly, 17 percent; needleandthread, 13 percent; bluebunch wheatgrass, 12 percent; sand dropseed, 10 percent; western wheatgrass, 3 percent; Indian ricegrass, 3 percent; little bluestem, 5 percent; prairie sandreed, 5 percent; perennial forbs, 15 percent; short grasses, 5 percent; upland sedges, 5 percent; and woody plants, 2 percent.

If this range site is in excellent condition, the estimated total annual production of all plant species is about 800 pounds (air-dry) per acre in favorable years and about 400 pounds per acre in unfavorable years. About 95 percent of this production is from plants that furnish forage for cattle, sheep, deer, and antelope.

Under continued heavy grazing, plains muhly, needleandthread, bluebunch wheatgrass, and sand dropseed are replaced by short grasses, forbs, red threeawn, sandwort, and sunflower.

Response to proper grazing management and planned grazing systems is slow on this site. This range site is not suited to mechanical treatment.

Very Shallow range site

This range site consists of the Ringling part of Lambert-Ringling complex, 15 to 65 percent slopes. These are very shallow to shallow, well drained, moderately steep to very steep soils that are underlain by angular cobble- and gravel-size shale fragments that have less than 5 percent fine material. In many places, especially on ridge crests and steep buttes, there are outcrops of shale that form boulders and have the appearance of scoria, or clinkers. Permeability is moderately rapid in the soil material and very rapid in the underlying cobbly and gravelly material, and the available water capacity is very low. Runoff is rapid to very rapid, and the hazard of erosion is high.

This site occurs throughout most of the uplands and makes up about 1 percent of the rangeland in the survey area. The vegetation on this site is generally about 85 percent grasses and sedges, 10 percent brush, and about 5 percent forbs. Approximate species composition (by air-dry weight) of the potential plant community is bluebunch wheatgrass, 30 percent; plains muhly, 12 percent; little bluestem, 11 percent; western wheatgrass, 10 percent; needleandthread, 7 percent; prairie sandreed, 5 percent; creeping juniper, 5 percent; skunkbush sumac, 5 percent; short grasses, 5 percent; perennial forbs, 5 percent; and upland sedges, 5 percent.

If this range site is in excellent condition, the estimated total annual production of all plant species is about 400 pounds per acre in favorable years and about 200 pounds per acre in unfavorable years. About 90 percent of this production is from plants that furnish forage for cattle, sheep, deer, and antelope.

Under continued heavy grazing, nearly all of the listed grasses are replaced by annuals, red threeawn, broom snakeweed, sandwort, and pussytoes.

When this site is overused, it responds slowly to proper grazing management and planned grazing systems. It is not suited to mechanical improvement or to range seeding because of the shallow depth of topsoil, the moderately steep slopes, and the rock outcrops.

Saline Upland range site

This range site consists of deep, well drained, nearly level to sloping soils on terraces and alluvial fans. The surface layer is clay loam, and the underlying layers are stratified alkali-affected fine sandy loam to clay

loam. Permeability is slow, and the available water capacity is high. Runoff is slow to medium, and the hazard of erosion is high.

This site occurs throughout the survey area along streams and bottoms of coulees, and it makes up about 0.5 percent of the rangeland. The vegetation on this site is generally about 55 percent mid grasses, 30 percent short grasses, 15 percent shrubs, and a small amount of perennial forbs. Approximate species composition (by air-dry weight) of the potential plant community is western wheatgrass, 30 percent; alkali sacaton, 5 percent; plains reedgrass, 5 percent; needleandthread, 5 percent; saltgrass, 5 percent; squirreltail, 5 percent; Nuttall saltbush, 8 percent; greasewood, 5 percent; short grasses, 30 percent; and perennial forbs, 2 percent.

If this range site is in excellent condition, the estimated total annual production of all plant species is about 600 pounds (air-dry) per acre in favorable years and about 300 pounds per acre in unfavorable years. About 90 percent of the production is from plants that furnish forage for cattle, sheep, deer, and antelope.

Under continued heavy grazing, western wheatgrass, alkali sacaton, squirreltail, Nuttall saltbush, and needleandthread are replaced by greasewood, false buffalograss, foxtail barley, short grasses, and annual plants.

Response to proper grazing management and planned grazing systems is good on this site. This range site is not well suited to mechanical improvement because of the hazard of erosion and the strong alkali conditions.

Wildlife[2]

Soil, topography, climate, a wide variety of native and other suitable kinds of vegetation, and other features combine to favor the development of wildlife habitat in Richland County. These features provide a high potential for managing the land to increase and maintain various kinds of wildlife. The principal kinds of native game are white-tailed deer, mule deer, pronghorn antelope, rink-necked pheasant, Hungarian partridge, and sharp-tailed and ruffed grouse. Furbearers include raccoons, foxes, skunks, and mink. Predators in the county include coyotes and bobcats. There are also numerous species of nongame birds.

Most ponds and lakes are stocked with trout, and the Missouri and the Yellowstone Rivers afford good to excellent fishing for trout and many other kinds of game fish. Ducks and geese use the lakes and streams during migration.

Successful management of wildlife on any tract of land requires, among other things, available food, cover, and water in a suitable combination. Lack of any of these necessities, unfavorable balance between them, or poor distribution of them may severely limit or eliminate desired wildlife species. Soil information provides a valuable tool in creating, improving, or maintaining suitable food, cover, and water for wildlife.

[2] Prepared by RONALD F. BATCHELOR, biologist, Soil Conservation Service, Bozeman, Montana.

Most wildlife habitat is managed by planting suitable vegetation, manipulating existing vegetation to bring about natural establishment, increasing or improving desired plants, or by combining these measures. The influence of soil on the growth and succession of plants can be predicted from knowledge of characteristics and behavior of the soil. In addition, water areas can be created or natural ones improved as wildlife habitat. Soil information is useful for these purposes.

Soil interpretations for wildlife habitat serve a variety of purposes. They help select the more suitable sites for various kinds of management; they indicate the intensity of management needed to achieve satisfactory results; and they show why it may not be feasible, generally, to manage a particular area for a given kind of wildlife.

These interpretations also serve in broad-scale planning of wildlife management areas, parks, and nature areas, or for acquiring land for wildlife.

The areas shown on the soil maps are rated on the type of soil, not on how they may be influenced by adjoining areas. Some influences on wildlife habitat, such as elevation and aspect, must be appraised onsite.

Soils directly influence the kind and amount of vegetation and the amount of water available, and in this way they indirectly influence the kind of wildlife that can live in an area. Soil properties that affect the growth of wildlife habitat are: (1) thickness of soil useful to crops, (2) surface texture, (3) available water capacity, (4) wetness, (5) surface stoniness or rockiness, (6) flood hazard, (7) slope, and (8) permeability of the soil to air and water.

In table 3, soils of this survey area are rated for their ability to produce six elements of wildlife habitat and to support three groups, or kinds, of wildlife. The ratings indicate relative suitability for various elements and are expressed by an adjective as follows:

A rating of *good* means the habitat is easily improved, maintained, or created. There are few or no soil limitations in management, and satisfactory results can be expected.

A rating of *fair* means the habitat can be improved, maintained, or created on these soils, but moderate soil limitations affect management or development. A moderate intensity of management and fairly frequent attention may be required to insure satisfactory results.

A rating of *poor* means the habitat can be improved, maintained, or created on these soils, but the soil limitations are severe. Management may be difficult and expensive and may require intensive effort. Results are questionable.

A rating of *very poor* means that under the prevailing soil conditions, it is impractical to attempt to improve, maintain, or create habitat. Unsatisfactory results are probable.

The significance of the ratings in table 3 is given in the following paragraphs.

Elements of wildlife habitat. Each soil is rated according to its suitability for producing various kinds of plants and other elements that make up wildlife habitat. The ratings take into account mainly the character-

TABLE 3.—*Suitability of the soils for elements of wildlife habitat and kinds of wildlife*

[Absence of an entry indicates that the soil was not rated]

Soil series and map symbols	Elements of wildlife habitat							K
	Grain and seed crops	Domestic grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland	
Adger: AdC	Poor	Fair	Fair	Fair			Fair	
Badland: Ba	Very poor	Very poor	Fair	Good			Poor	
Banks: BkB	Fair	Good	Fair	Good	Very poor	Very poor	Fair	
Beaverton Mapped only with Turner soils.	Poor	Poor	Good	Fair			Fair	
Benz: BmB, BnC For Trembles part of BnC, see Trembles series.	Poor	Fair	Fair	Poor			Fair	
Blanchard Mapped only with Lamber and Dast soils.	Poor	Fair	Good	Fair			Fair	
Bowbells: BoB	Fair	Good	Good	Good	Good	Good	Good	
Cherry: CeA, CeC, Ch For Havrelon and Trembles part of Ch, see Havrelon and Trembles series.	Fair	Good	Good	Good			Good	
Dast: DbD For Blanchard part, see Blanchard series.	Poor	Fair	Good	Fair			Fair	
Dimyaw: DmD	Poor	Fair	Good	Good			Fair	
Dooley: DoB	Fair	Good	Good	Fair			Good	
Farnuf: FaA, FaB	Fair	Good	Good	Good			Good	
Havrelon: HaA, HaB, Hb	Fair	Good	Good	Good	Poor	Poor	Good	
Hoffmanville: Ho	Fair	Fair	Good	Good	Fair	Fair	Fair	
Lambert: LaE, LbC, LbD, Lc, LeD, LfF, LhF. For Badland part of Lc, see Badland; for Blanchard part of LeD, see Blanchard series; for Dimyaw part of LfF, see Dimyaw series; and for Ringling part of LhF, see Ringling series.	Fair	Good	Good	Good			Good	
Lihen: LmD	Poor	Fair	Good	Good			Fair	
Lohler:								
Lo, Lp	Fair	Fair	Good	Good	Fair	Fair	Fair	
Lw	Poor	Poor	Good	Good	Good	Good	Poor	

Marias: Ma	Fair	Fair	Good	Fair			Fair
Ridgelawn: Rd	Fair	Fair	Good	Good	Very poor	Fair	Fair
Ringling Mapped only with Lambert soils.	Poor	Fair	Good	Fair			Fair
Riverwash: Rw	Very poor	Very poor	Very poor	Poor	Very poor	Fair	Very poor
Savage: SaA, SaB	Fair	Good	Good	Good			Good
Shambo: ShA, ShB, ShC, SmC, SmD For Lambert part of SmC and SmD, see Lambert series.	Fair	Good	Good	Fair			Good
Strip mines, reclaimed: St. No estimates made because properties are too variable; onsite investigation needed.							
Tally: TaA, TaB, TaC	Fair	Good	Good	Fair			Good
Tinsley: TeF	Very poor	Very poor	Fair	Fair			Poor
Trembles: Tm	Fair	Good	Good	Good	Very poor	Very poor	Good
Turner: ToB For Beaverton part, see Beaverton series.	Fair	Good	Good	Poor			Fair
Typic Haplaquents: Tw	Poor	Poor	Fair	Poor	Good	Good	Poor
Vanda: Va	Poor	Fair	Fair	Poor			Poor
Vida: VdB, VdC, VhC, VhD For Zahill part of VhC and VhD, see Zahill series.	Fair	Good	Good	Fair	Good	Good	Good
Williams: WmB	Fair	Good	Good	Fair	Good	Good	Good
Zahill: ZaF, ZbF For Lambert part of ZbF, see Lambert series.	Poor	Fair	Fair	Good			Fair

istics of the soils and closely related natural factors of the environment. They do not take into account climate, present use of the soils, or present distribution of wildlife and population. For this reason, selection of a site for development of wildlife habitat requires inspection of the site.

Grain and seed crops are annual grain-producing plants, such as wheat, barley, and oats.

Domestic grasses and legumes are established by planting. They provide food and cover for wildlife. Grasses include ryegrass, creeping meadow foxtail, bluegrass, and timothy. Legumes include alfalfa, sainfoin, trefoil, and other clovers.

Wild herbaceous plants are native or introduced perennial grasses, forbs, and weeds that provide food and cover for upland wildlife. Perennial forbs, sagewort, pokeweed, and cheatgrass are typical examples. On rangeland, typical plants are bluestem, grama, wheatgrasses, perennial forbs, and legumes.

Shrubs are plants that produce buds, twigs, bark, or foliage used as food by wildlife, or provide cover and shade for some wildlife species. Typical plants in this category are chokecherry, buffaloberry, snowberry, sumac, cinquefoil, rosebush, wild plum, big sagebrush, and greasewood.

Wetland plants are annual and perennial herbaceous plants that grow wild on moist and wet sites. They furnish food and cover mostly for wetland wildlife. Typical examples are cordgrass, smartweed, mannagrass, cattails, saltgrass, rushes, sedges, sloughgrass, and canarygrass. Submerged and floating aquatics are not included in this category.

Shallow water areas are areas of surface water that have an average depth of less than 5 feet and are useful to wildlife. They may be naturally wet areas or created by dams or levees or by water-control devices in marshes or streams. Typical examples are waterfowl feeding areas, wildlife watering developments, wildlife ponds, and beaver ponds.

Kinds of wildlife. Each soil is rated according to its suitability as habitat for the three kinds of wildlife in the county—openland, wetland, and rangeland wildlife. These ratings are related to those made for the elements of habitat. For example, soils rated *very poor* for shallow water developments are rated *very poor* for wetland wildlife.

Openland wildlife consists of birds and mammals of cropland, pasture, meadows, lawns, and areas overgrown with grasses, herbs, shrubs, and vines. Examples are quail, pheasant, meadowlark, field sparrow, killdeer, doves, cottontail rabbit, red fox, and woodchuck.

Wetland wildlife consists of birds and mammals of swampy, marshy, or open water areas. Examples are ducks, geese, herons, pelicans, cranes, shore birds, rails, kingfishers, muskrat, mink, beaver, and otter.

Rangeland wildlife consists of birds and mammals of natural rangeland. Examples are antelope, whitetailed deer, mule deer, sharp-tailed grouse, chukar, quail, sage grouse, meadowlark, lark bunting, hawks, owls, and jackrabbits.

Engineering[3]

This section is useful to planning commissioners, town and city managers, land developers, engineers, contractors, farmers, and others who need information about soils used as structural material or as foundations on which structures are built.

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, drainage, shrink-swell potential, grain size, plasticity, and reaction. Also important are depth to the water table, depth to bedrock, and slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who (1) select potential residential, industrial, commercial, and recreational areas; (2) evaluate alternate routes for roads, highways, pipelines, and underground cables; (3) seek sources of gravel, sand, or clay; (4) plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil; (5) correlate performance of structures already built with properties of the soils on which they are built to help predict performance of structures on the same or similar kinds of soil in other locations; (6) predict the trafficability of soils for cross-country movement of vehicles and construction equipment; and (7) develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables. Table 4 shows estimated soil properties significant to engineering. Table 5 gives interpretations for various engineering uses. Table 6 gives interpretations for town and country planning.

This information, along with the soil map and data in other parts of this publication, can be used to make interpretations in addition to those given in tables 4, 5, and 6. It also can be used to make useful maps.

This information, however, does not eliminate the need for further investigation at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths of more than 6 feet. Also, inspection of sites, especially the small ones, is needed because many mapped areas of a given soil can include small areas of other kinds of soils that have strongly contrasting properties and different suitability or limitations for soil engineering.

Some of the terms used in this survey have special meaning in soil science. The Glossary defines many of these terms.

Engineering soil classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system

[3] JOSEPH W. KENNEDY, engineer, Soil Conservation Service, assisted in preparation of this section.

(*2*) used by Soil Conservation Service engineers, the Department of Defense, and others; and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (*1*).

In the Unified system, soils are classified according to particle-size distribution, plasticity, liquid limit, and organic matter content. Soils are grouped in 15 classes. There are eight classes of coarse grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes fine grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes, for example, CL-ML.

The AASHTO system is used to classify soils according to properties that affect their use in highway construction and maintenance. In this system, a soil is placed in 1 of 7 basic groups ranging from A-1 to A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A-1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). In group A-7 are clay soils that have low strength when wet and that are the poorest soils for subgrade.

The estimated AASHTO and Unified classifications are given in table 4 for all soils mapped in the survey area.

Soil properties significant in engineering

Several estimated soil properties significant in engineering are given in table 4. These estimates are made for representative soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the column headings in table 4.

Depth to bedrock is not given because most soils in the county are so deep over bedrock that bedrock generally does not affect their use. Soft shale is at a depth of 40 to 60 inches in Dimyaw soils, and soft sandstone is at a depth of 20 to 40 inches in Dast soils. Hoffmanville and Ridgelawn soils are underlain by sand at a depth of 20 to 40 inches. Beaverton and Turner soils are underlain by sand and gravel at a depth of 10 to 20 inches and 20 to 40 inches, respectively. Ringling soils are underlain by gravel and cobblestones at a depth of 10 to 20 inches.

Depth to water table is not given because soils in Richland County, except Lohler clay, wet, and Typic Haplaquents, are so deep to the water table that it does not affect their use. Typic Haplaquents and Lohler clay, wet, have a water table within 5 feet of the surface most of the time and at or near the surface during most of the growing season.

Soil texture is described in standard terms used by the Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used are defined in the Glossary of this soil survey.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis of those soil characteristics observed in the field, particularly structure and texture. The estimates do not take into account lateral seepage of such transient soil feaures as plowpans and surface crusts.

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH values. The pH value and terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential is the relative change in volume of soil material to be expected with changes in moisture content, that is, the extent to which the soil shrinks as it dries out or swells when it becomes wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to the maintenance of structures built in, on, or with material having this rating.

Frost-action potential is the possible upward or lateral movement of soil by the formation of ice lenses and the subsequent collapse upon thawing. Estimates of frost-action potential are of soil not covered with vegetation or snow. Under these conditions the most severe frost action is likely to occur.

The corrosivity potential of soils for uncoated steel and concrete pipe are not given in table 4. Most soils in the county have a high corrosivity potential for uncoated steel pipe and a low corrosivity potential for concrete. Corrosivity pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. Rate of corrosion of uncoated steel is related to soil properties such as drainage, texture, total acidity, and electrical conductivity of the soil material. Corrosivity for concrete is influenced mainly by the content of sodium or magnesium sulfate, but also by soil texture and acidity. Installations of uncoated steel pipe that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon.

Testing soils for the soil properties related to corrosion of uncoated steel pipe and concrete is desirable to determine if corrosivity is a problem and to what degree.

Engineering interpretations

The estimated interpretations in table 5 are based on the engineering properties of soils shown in table 4, on test data for soils in this survey area and others

TABLE 4.—*Estimated physical*

[An asterisk in the first column indicates that at least one mapping unit in that series is made up of two or more kinds of soil. series as indicated. The symbol < means

Soil series and map symbols	Depth from surface	Dominant USDA texture	Classification		Percentage larger than 3 inches
			Unified	AASHTO	
	Inches				
Adger: AdC	0–60	Silty clay	CL or CH	A–6 or A–7	0
Badland: Ba. No estimates made because properties are too variable; onsite investigation needed.					
Banks: BkB	0–60	Stratified loamy fine sand, fine sand, and fine sandy loam.	SM	A–2	0
Beaverton. Mapped only with Turner soils.	0–18	Gravelly clay loam	GC or GM	A–2 or A–6	0
	18–60	Gravelly sand	GP	A–1	0–20
*Benz: BmB, BnC. For Trembles part of BnC, see Trembles series.	0–22	Clay loam	CL	A–6	0
	22–60	Stratified fine sandy loam and loam.	ML or SM	A–4	0
Blanchard. Mapped only with Dast and Lambert soils.	0–60	Loamy fine sand	SM	A–2	0
Bowbells: BoB	0–60	Clay loam	CL	A–6	0–10
*Cherry: CeA, CeB, CeC, Ch. For Havrelon and Trembles part of Ch, see Havrelon and Trembles series.	0–60	Silty clay loam	CL	A–6	0
*Dast: DbD. For Blanchard part, see Blanchard series.	0–21	Fine sandy loam	SM	A–4	0
	21–60	Soft sandstone.			
Dimyaw: DmD	0–60	Silty clay loam	CL	A–6 or A–7	0
Dooley: DoB	0–27	Sandy loam or sandy clay loam.	SM or SC	A–4 or A–6	0
	27–60	Clay loam	CL	A–6	0–10
Farnuf: FaA, FaB	0–60	Clay loam or light clay loam.	CL or ML	A-4 or A-6	0
Havrelon: HaA, HaB, Hb	0–60	Stratified loam, silt loam, fine sandy loam, and silty clay loam.	ML	A–4	0
Hoffmanville: Ho	0–28	Silty clay	CL	A–6 or A–7	0
	28–60	Loamy fine sand	SM	A–2	0
*Lambert: LaE, LbC, LbD, Lc, LeD, LfF, LhF. For Badland part of Lc, no ratings; for Blanchard part of LeD, see Blanchard series; for Dimyaw part of LfF, see Dimyaw series; and for Ringling part of LhF, see Ringling series.	0–60	Silt loam	ML	A–4	0
Lihen: LmD	0–60	Loamy fine sand	SM	A–2	0
Lohler: Lo, Lp, Lw	0–25	Silty clay loam	CL or CH	A–6 or A–7	0
	25–60	Silty clay	CH	A–7	0
Marias: Ma	0–60	Silty clay	CH	A–7	0
Ridgelawn: Rd	0–24	Loam	CL or CL–ML	A–4 or A–6	0
	24–60	Fine sand	SM	A–2	0

and chemical properties of the soils

The soil in such mapping units can have different properties and limitations, and for this reason it is necessary to refer to other less than; the symbol > means more than]

Percentage less than 3 inches passing sieve—				Permea-bility	Available water capacity	Reaction	Shrink-swell potential	Frost action potential
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)					
				Inches per hour	*Inches per inch of soil*	*pH*		
	100	95–100	90–95	0.06–0.2	0.16–0.18	7.4–9.6	High	Low.
90–100	85–90	75–90	25–35	6.0–20.0	0.10–0.14	7.4–8.4	Low	Low.
50–60	40–50	35–50	30–40	0.6–2.0	0.12–0.15	7.0–8.4	Low	Moderate.
30–50	25–50	15–35	0–5	>20.0	<0.03	7.4–8.4	Low	Low.
	100	95–100	80–90	0.06–0.2	0.16–0.18	8.5–9.6	Moderate	Moderate.
	100	70–95	45–75	0.06–0.2	0.14–0.18	8.5–9.6	Moderate	Moderate.
	100	75–90	25–35	6.0–20.0	0.10–0.12	7.0–7.8	Low	Low.
85–100	85–95	70–85	65–75	0.2–0.6	0.16–0.20	7.4–9.0	Moderate	Moderate.
	100	95–100	85–95	0.2–0.6	0.18–0.20	7.9–8.4	Moderate	Moderate.
	100	70–85	35–50	2.0–6.0	0.10–0.14	7.9–8.4	Low	Moderate.
	100	95–100	85–95	0.06–0.2	0.16–0.20	7.4–8.4	High	Moderate.
100	95–100	70–85	35–50	0.6–2.0	0.10–0.14	7.4–8.4	Low	Moderate.
85–95	80–95	70–80	60–75	0.2–0.6	0.16–0.20	7.4–9.0	Moderate	Moderate.
	100	85–100	60–80	0.6–2.0	0.16–0.20	7.4–8.4	Moderate	Moderate.
	100	85–100	70–85	0.6–2.0	0.16–0.20	7.9–8.4	Low	Moderate.
	100	95–100	90–95	0.06–0.2	0.18–0.20	7.9–8.4	Moderate	Moderate.
	100	75–90	25–35	6.0–20.0	0.08–0.12	7.4–8.4	Low	Moderate.
	100	90–100	75–90	0.2–0.6	0.16–0.20	7.9–8.4	Low	Moderate.
	100	75–90	25–35	6.0–20.0	0.08–0.12	7.0–7.8	Low	Low.
	100	95–100	85–95	0.2–0.6	0.16–0.20	7.9–8.4	High	Moderate.
	100	95–100	90–95	0.2–0.6	0.18–0.20	7.9–8.4	High	Low.
	100	95–100	90–100	<0.06	0.16–0.18	7.9–9.6	High	Low.
	100	90–100	80–95	0.6–2.0	0.16–0.20	7.4–8.4	Low	Moderate.
	100	65–80	15–35	6.0–20.0	0.04–0.08	7.4–8.4	Low	Low.

TABLE 4.—*Estimated physical*

Soil series and map symbols	Depth from surface	Dominant USDA texture	Classification		Percentage larger than 3 inches
			Unified	AASHTO	
	Inches				
Ringling. Mapped only with Lambert soils.	0–12 12–36	Channery loam Angular cobble- and gravel-size shale fragments.	GM	A–4	0–10
Riverwash: Rw. No estimates made because properties are too variable; onsite investigation needed.					
Savage: SaA, SaB	0–60	Silty clay and silty clay loam.	CL or CH	A–6 or A–7	0
*Shambo: ShA, ShB, ShC, SmC, SmD. For Lambert part of SmC and SmD, see Lambert series.	0–60	Loam	CL–ML or ML	A–4	0
Strip mines, reclaimed: St. No estimates made because properties are too variable; onsite investigation needed.					
Tally: TaA, TaB, TaC	0–60	Fine sandy loam	SM	A–4	0
Tinsley: TeF	0–60	Very gravelly sand and gravelly sand.	GP	A–1	0–20
Trembles: Tm	0–60	Fine sandy loam	SM	A–4	0
*Turner: ToB. For Beaverton part, see Beaverton series.	0–26 26–60	Clay loam Very gravelly loamy sand and gravelly loamy sand.	CL or ML GP–GM or GM	A–4 or A–6 A–1	0 10–20
Typic Haplaquents: Tw. No estimates made because properties are too variable; onsite investigation needed.					
Vanda: Va	9–60	Clay or silty clay	CH or CL	A–7	0
*Vida: VdB, VdC, VhC, VhD. For Zahill part of VhC and VhD, see Zahill series.	0–60	Loam, clay loam, or gravelly clay loam.	CL or ML	A–4 or A–6	5–10
Williams: WmB	0–60	Clay loam	CL	A–6	0–10
*Zahill: ZaF, ZbF. For Lambert part of ZbF, see Lambert series.	0–60	Clay loam	CL	A–6	5–10

nearby or adjoining, and on the experience of engineers and soil scientists with the soils of Richland County. In table 5 ratings are given for the suitability of the soils as a source of topsoil, sand and gravel, and roadfill. Ratings for drainage of cropland and pasture, irrigation, ponds and reservoirs, embankments, and terraces and diversions list those soil features not to be overlooked in planning, installation, and maintenance.

Suitability ratings are expressed as *good, fair,* and *poor. Good* means soil properties generally are favorable for the given use or, in other words, the limitations are minor and easily overcome. *Fair* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Poor* means soil properties are so unfavorable and so difficult to correct or overcome that major soil reclamation and special designs are needed.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as in preparing a seedbed; natural fertility of the material or plant response when fertilizer is added to the soil; and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments affect suitability. Also considered in the ratings is damage that can result in the area from which topsoil is taken.

Sand and gravel is used in great quantities in many kinds of construction. The ratings provide guidance as to where to look for probable sources. A soil rated as a *good* or *fair* source generally has a layer of sand or gravel at least 3 feet thick, the top of which is within

and chemical properties of the soils—Continued

Percentage less than 3 inches passing sieve—				Permeability	Available water capacity	Reaction	Shrink-swell potential	Frost action potential
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)					
				Inches per hour	*Inches per inch of soil*	*pH*		
60–70	50–70	50–60	35–50	2.0–6.0	0.12–0.16	7.4–8.4	Low	Low.
	100	95–100	85–95	0.2–0.6	0.16–0.20	7.4–8.4	High	Moderate.
	100	85–95	60–75	0.6–2.0	0.16–0.20	7.4–8.4	Low	Moderate.
	100	70–85	35–50	2.0–6.0	0.14–0.16	7.0–8.4	Low	Moderate.
35–50	25–50	15–35	0–5	6.0–20.0	<0.03	7.4–8.4	Low	Low.
	100	70–85	35–50	2.0–6.0	0.14–0.16	7.4–8.4	Low	Moderate.
90–95	85–90	80–90	50–70	0.6–2.0	0.16–0.20	7.4–8.4	Moderate	Moderate.
35–50	25–50	12–35	5–15	6.0–20.0	<0.03	7.4–8.4	Low	Low.
		100	90–95	<0.06	0.10–0.13	8.5–9.6	High	Low.
75–85	70–80	70–80	65–75	0.2–0.6	0.16–0.20	7.4–9.0	Moderate	Moderate.
85–100	80–95	70–80	65–75	0.2–0.6	0.16–0.20	7.4–9.0	Moderate	Moderate.
90–95	90–95	85–90	70–80	0.2–0.6	0.16–0.20	7.4–9.0	Moderate	Moderate.

a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials, nor do they indicate quality of the deposit.

Roadfill is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the relative ease of excavating the material at borrow areas.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage and piping and that is of favorable stability, shrink-swell potential, shear strength, and compactibility. Stones or organic material in a soil are among factors that are unfavorable.

Drainage of cropland pasture is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence rate of water movement; depth to the water table; slope; stability in ditchbanks; susceptibility to stream overflow; salinity or alkalinity; and availability of outlets for drainage.

Irrigation of a soil is affected by such featuers as slope; susceptibility to stream overflow, water erosion, and soil blowing; soil texture; content of stones; accumulation of salts and alkali; depth of root zone; rate of water intake at the surface; permeability be-

TABLE 5.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in that series is made up of two or more kinds of soil. series as

Soil series and map symbols	Suitability as a source of— Topsoil	Sand and gravel	Roadfill and subgrade
Adger: AdC	Poor: silty clay; strongly alkaline to very strongly alkaline.	Not suitable; excessive fines.	Poor: high shrink-swell potential; low shear strength.
Badland: Ba No estimates made because properties are too variable; onsite investigation needed.			
Banks: BkB	Poor: loamy fine sand; susceptible to soil blowing; droughty.	Poor: sand with excessive fines; no gravel.	Good
Beaverton Mapped only with Turner soils.	Poor: 35 to 45 percent gravel	Good for gravel and sand below a depth of 10 to 20 inches.	Good: difficult to revegetate borrow areas.
*Benz: BmB, BnC For Trembles part of BnC, see Trembles series.	Poor: strongly alkaline to very strongly alkaline.	Not suitable; excessive fines.	Fair: medium to low shear strength; moderate frost action potential; moderate shrink-swell potential.
Blanchard Mapped only with Dast and Lambert soils.	Poor: loamy fine sand	Poor: sand has excessive fines; no gravel.	Fair: fair compaction characteristics; medium shear strength; difficult to revegetate borrow areas.
Bowbells: BoB	Fair: clay loam	Not suitable; excessive fines.	Fair: moderate frost action potential; medium to low shear strength; moderate shrink-swell potential.
*Cherry: CeA, CeB, CeC, Ch For Havrelon and Trembles part of Ch, see Havrelon and Trembles series.	Fair: silty clay loam	Not suitable; excessive fines.	Poor: low shear strength
*Dast: DbD For Blanchard part, see Blanchard series.	Fair if slope is 8 to 15 percent. Poor if slope is 15 to 25 percent: difficult to revegetate borrow areas.	Not suitable; excessive fines.	Fair if slope is 8 to 15 percent: moderate frost action potential; difficult to revegetate borrow areas. Poor if slope is 15 to 25 percent.
Dimyaw: DmD	Fair if slope is 8 to 15 percent: silty clay loam. Poor if slope is 15 to 65 percent.	Not suitable; excessive fines.	Poor: high shrink-swell potential; low shear strength; 25 to 65 percent slopes.
Dooley: DiB	Fair: sandy clay loam	Not suitable; excessive fines.	Fair: moderate frost action potential; moderate shrink-swell potential.

interpretations

The soils in such mapping units can have different properties and limitations, and for this reason it is necessary to refer to other indicated]

Soil features affecting—				
Pond reservoir areas	Embankments, dikes, and levees	Drainage for crops and pasture	Irrigation	Terraces, waterways, and diversions
0 to 8 percent slopes	High shrink-swell potential; fair compaction characteristics; low shear strength; high compressibility.	Slow permeability; strongly alkaline to very strongly alkaline; 0 to 8 percent slopes.	Not used	Strongly alkaline to very strongly alkaline; slow permeability; susceptible. to erosion; 0 to 8 percent slopes.
Rapid permeability	Medium shear strength; low resistance to piping.	0 to 4 percent slopes	Moderate available water capacity; rapid permeability; susceptible to erosion.	Susceptible to soil blowing, erosion, and siltation; low resistance to piping.
Very rapid permeability below a depth of 10 to 20 inches.	High compacted permeability; low resistance to piping.	0 to 4 percent slopes	Low available water capacity; very rapid permeability below a depth 10 to 20 inches; 0 to 8 percent slopes.	Sand and gravel below a depth of 10 to 20 inches; low resistance to piping
0 to 8 percent slopes	Medium to low shear strength; low resistance to piping; fair compaction characteristics.	Slow permeability; strongly alkaline to very strongly alkaline; 0 to 8 percent slopes.	Not used	Strongly alkaline to very strongly alkaline; slow permeability; low resistance to piping; 0 to 8 percent slopes.
Rapid permeability; 8 to 25 percent slopes.	High susceptibility to piping; medium shear strength; medium to high compacted permeability.	Unstable banks; 8 to 25 percent slopes.	Not used	8 to 25 percent slopes; susceptible to soil blowing; high susceptibility to piping; low available water capacity.
All features favorable	Moderate shrink-swell potential; low to medium shear strength; fair to good compaction characteristics.	Moderately slow permeability; poor availability of outlets; 0 to 4 percent slopes.	Not used	Moderately slow permeability; 0 to 4 percent slopes.
Moderately slow permeability; 0 to 8 percent slopes.	Low shear strength; moderate frost action potential; moderate shrink-swell potential.	Moderately slow permeability.	0 to 8 percent slopes; moderately slow permeability.	Moderately slow permeability; 0 to 8 percent slopes.
Moderately rapid permeability; soft sandstone at a depth of 20 to 40 inches; 8 to 25 percent slopes.	Low resistance to piping; medium compressibility; medium shear strength; medium compacted permeability; thin layer.	Soft sandstone at a depth of 20 to 40 inches; 8 to 25 percent slopes.	Not used	8 to 25 percent slopes; soft sandstone at a depth of 20 to 40 inches; low available water capacity.
8 to 65 percent slopes	Low shear strength; medium compressibility; high shrink-swell potential.	8 to 65 percent slopes; slow permeability.	Not used	8 to 65 percent slopes; high hazard of erosion; slow permeability.
2 to 6 percent slopes	Low resistance to piping above a depth of 20 to 40 inches; medium to low shear strength.	Moderate permeability; moderately slow below a depth of 20 to 40 inches; 2 to 6 percent slopes.		Susceptible to soil blowing; low resistance to piping above a depth of 20 to 40 inches; moderately slow permeability below a depth of 20 to 40 inches.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as a source of— Topsoil	Sand and gravel	Roadfill and subgrade
Farnuf: FaA, FaB	Fair: clay loam	Not suitable; excessive fines.	Fair: moderate frost action potential; moderate shrink-swell potential.
Havrelon: HaA, HaB, Hb	Good: if silt loam, fair if silty clay loam.	Not suitable; excessive fines.	Fair: moderate frost action potential; low shear strength.
Hoffmanville: Ho	Poor: silty clay to a depth of 28 inches; loamy fine sand below a depth of 28 inches; difficult to revegetate borrow areas.	Not suitable; excessive fines.	Fair: moderate shrink-swell potential to a depth of 28 inches; loamy fine sand below a depth of 28 inches; difficult to revegetate borrow areas.
*Lambert: LaE, LbC, LbD, Lc, LeD, LfF, LhF. No estimates for Badland part of Lc; for Blanchard part of LeD, see Blanchard series; for Dimyaw part of LfF, see Dimyaw series part fo LhF, and for Ringling see Ringling series.	Good if slope is 2 to 8 percent. Fair if slope is 8 to 15 percent. Poor if slope is 15 to 65 percent.	Not suitable; excessive fines.	Poor: slope is 2 to 65 percent; low shear strength; moderate frost action potential.
Lihen: LmD	Poor: loamy fine sand	Poor: sand has excessive fines; no gravel.	Fair: fair compaction characteristics; medium shear strength.
Lohler:			
Lo, Lp	Poor: clayey	Not suitable: excessive fines.	Poor: high shrink-swell potential; low shear strength.
Lw	Poor: clayey; wet		Poor: high shrink-swell potential; wet; low shear strength.
Marias: Ma	Poor: silty clay; strongly alkaline to very strongly alkaline.	Not suitable; excessive fines.	Poor: high shrink-swell potential; low shear strength.
Ridgelawn: Rd	Good to a depth of 24 inches: loamy materials. Poor below a depth of 24 inches fine sand; difficult to revegetate borrow areas.	Poor: fine sand with excessive fines below a depth of 24 inches; no gravel.	Fair: moderate frost action potential to a depth of 24 inches; fine sand below; difficult to revegetate borrow areas.
Ringling. Mapped only with Lambert soils.	Poor: 95 to 100 percent angular gravel and cobble fragments.	Poor: material 45 to 65 percent greater than 3 inches in size.	Fair if slope is 15 to 25 percent. Poor if slope is 25 to 65 percent.
Riverwash: Rw. No estimates made because properties are too variable; onsite investigation needed.			
Savage: SaA, SaB	Poor: silty clay	Not suitable; excessive fines.	Poor: high shrink-swell potential; low shear strength.

interpretations—Continued

Soil features affecting—				
Pond reservoir areas	Embankments, dikes, and levees	Drainage for crops and pasture	Irrigation	Terraces, waterways, and diversions
Moderate permeability	Low to medium resistance to piping; medium compressibility; low to medium shear strength.	0 to 4 percent slopes	0 to 4 percent slopes	All features favorable.
Moderate permeability	Low resistance to piping; shear strength; medium compressibility.	0 to 4 percent slopes	0 to 4 percent slopes	All features favorable.
Rapid permeability below a depth of 28 inches.	Low shear strength above a depth of 28 inches; low resistance to piping below a depth of 28 inches.	Slow permeability above a depth of 28 inches; unstable banks below a depth of 28 inches.	Moderate available water capacity; slow permeability above a depth of 28 inches; rapid permeability below a depth of 28 inches.	Moderate available water capacity; slow permeability above a depth of 28 inches; rapid permeability below a depth of 28 inches.
0 to 65 percent slopes	Low resistance to piping; low shear strength; medium compressibility.	Moderately slow permeability; 2 to 65 percent slopes.	Not used	Moderate to high hazard of erosion; 2 to 65 percent slopes; low resistance to piping; moderately slow permeability.
Rapid permeability; 4 to 15 percent slopes.	Medium shear strength; low resistance to piping; medium compacted permeability.	4 to 15 percent slopes; unstable banks.	Not used	Susceptible to soil blowing; 4 to 15 percent slopes; susceptible to piping, erosion, and siltation.
All features favorable	Low shear strength; medium to high compressibility; high shrink-swell potential.	Moderately slow permeability.	Moderately slow permeability.	Moderately slow permeability.
All features favorable	Low shear strength; medium to high compressibility; high shrink-swell potential.	Moderately slow permeability; poor availability of outlets.	Not used	Moderately slow permeability; wet.
All features favorable	High shrink-swell potential; low shear strength; fair to poor compaction characteristics; high compressibility.	Very slow permeability; strongly alkaline to very strongly alkaline.	Slow permeability	Very slow permeability; strongly alkaline to very strongly alkaline.
Rapid permeability below a depth of 24 inches.	Low shear strength; low resistance to piping; rapid permeability.	Unstable banks below a depth of 24 inches.	Moderate available water capacity; rapid permeability below a depth of 24 inches.	Fine sand below a depth of 24 inches; low resistance to piping.
Very rapid permeability to a depth of 12 inches; 15 to 25 percent slopes.	45 to 65 percent greater than 3 inches in size; high compacted permeability.	15 to 65 percent slopes	Not used	Very low available water capacity; 15 to 65 percent slopes; 95 to100 percent angular gravel and cobble fragments.
All features favorable	High shrink-swell potential; low shear strength; fair compaction characteristics.	Moderately slow permeability; 0 to 4 percent slopes.	Moderately slow permeability; 0 to 4 percent slopes.	Moderately slow permeability.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as a source of— Topsoil	Sand and gravel	Roadfill and subgrade
*Shambo: ShA, ShB, ShC, SmC, SmD. For Lambert part of SmC and SmD, see Lambert series.	Good if slope is 0 to 8 percent. Fair if slope is 8 to 15 percent.	Not suitable; excessive fines.	Fair: moderate frost action potential.
Strip mines, reclaimed: St. No estimates made because properties are too variable; onsite investigation needed.			
Tally: TaA, TaB, TaC	Good if slope is 0 to 8 percent. Fair if slope is 8 to 12 percent.	Not suitable; excessive fines.	Fair: moderate frost action potential.
Tinsley: TeF	Poor: slope is 15 to 65 percent; 95 to 100 percent sand and gravel.	Good	Fair if slope is 15 to 25 percent. Poor if slope is 25 to 65 percent.
Trembles: Tm	Good	Not suitable; excessive fines.	Fair: moderate frost action potential.
*Turner: ToB. For Beaverton part, see Beaverton series.	Fair above a depth of 26 inches: clay below. Poor below a depth of 26 inches: loose sand and gravel.	Good below a depth of 26 inches.	Fair to a depth of 26 inches; moderate frost action potential; good below a depth of 26 inches.
Typic Haplaquents: Tw. No estimates made because properties are too variable; onsite investigation needed.			
Vanda: Va	Poor: clay; strongly alkaline to very strongly alkaline.	Not suitable; excessive fines.	Poor: high shrink-swell potential; low shear strength.
*Vida: VsB, VdC, VhC, VhD. For Zahill part of VhC and VhD, see Zahill series.	Fair: slope is 1 to 15 percent; clay loam.	Not suitable; excessive fines.	Fair: moderate frost action potential; medium to low shear strength; moderate shrink-swell potential.
Williams: WmB	Fair: clay loam	Not suitable; excessive fines.	Fair: moderate frost action potential; medium to low shear strength; moderate shrink-swell potential.
*Zahill: ZaF, ZbF. For Lambert part of ZbF, see Lambert series.	Fair if slope is 4 to 15 percent: clay loam. Poor if slope is 15 to 65 percent.	Not suitable; excessive fines.	Fair if slope is 4 to 25 percent: moderate frost action potential; moderate shrink-swell potential; medium to low shear strength. Poor if slope is 25 to 65 percent.

interpretations—Continued

Soil features affecting—				
Pond reservoir areas	Embankments, dikes, and levees	Drainage for crops and pasture	Irrigation	Terraces, waterways, and diversions
Moderate permeability; 0 to 15 percent slopes.	Low resistance to piping; medium to low shear strength; fair compaction characteristics.	0 to 15 percent slopes	0 to 15 percent slopes	Slight to high hazard of erosion; low resistance to piping; 0 to 15 percent slopes.
Moderately rapid permeability; 0 to 12 percent slopes.	Low resistance to piping; medium shear strength; low to medium compressibility; medium compacted permeability.	Moderate frost action potential; 0 to 12 percent slopes.	0 to 12 percent slopes; moderately rapid permeability; moderate available water capacity.	Slight to high hazard of erosion; moderate to high hazard of soil blowing; 0 to 12 percent slopes; low resistance to piping.
Rapid permeability; 15 to 65 percent slopes.	High compacted permeability; low resistance to piping.	15 to 65 percent slopes; unstable banks.	Not used	Very low available water capacity; 15 to 65 percent slopes; 95 to 100 percent sand and gravel; low resistance to piping.
Moderately rapid permeability; 0 to 8 percent slopes.	Low resistance to piping; low to medium compressibility; medium shear strength.	0 to 8 percent slopes; hazard of flooding.	0 to 8 percent slopes; moderately rapid permeability; hazard of flooding.	0 to 8 percent slopes; susceptible to soil blowing; susceptible to erosion; low resistance to piping.
Rapid permeability below a depth of 26 inches.	Low to medium resistance to piping; fair compaction characteristics above a depth of 26 inches; sand and gravel; rapid permeability below a depth of 26 inches.	Moderate frost action above a depth of 26 inches; 0 to 4 percent slopes.	Moderate available water capacity; 0 to 4 percent slopes; rapid permeability below a depth of 26 inches.	Moderate available water capacity; sand and gravel below a depth of 26 inches.
All features favorable	Low shear strength; high shrink-swell potential; fair to poor compaction characteristics; high compressibility.	Very slow permeability	Not used	Strongly alkaline to very strongly alkaline; very slow permeability; moderate available capacity.
1 to 15 percent slopes	Moderate susceptibility to piping; moderate shrink-swell potential; medium to low shear strength; fair to good compaction characteristics.	Moderately slow permeability; 1 to 15 percent slopes.	Not used	1 to 15 percent slopes; moderately slow permeability.
All features favorable	Moderate shrink-swell potential; medium to low shear strength; fair to good compaction characteristics.	Moderately slow permeability; 0 to 4 percent slopes.	Not used	Moderately slow permeability.
4 to 65 percent slopes	Moderate shrink-swell potential; medium to low shear strength; fair to good compaction characteristics.	Moderately slow permeability; 4 to 65 percent slopes.	Not used	4 to 65 percent slopes; high hazard of erosion.

TABLE 6.—*Degree and kind of limitation*

[An asterisk in the first column indicates that at least one mapping unit in that series is made up of two or more kinds of soil. series as

Soil series and map symbols	Community development				
	Dwellings	Septic tank absorption fields	Sewage lagoons	Sanitary landfill (trench)	Shallow excavations
Adger: AdC	Severe; high shrink-swell potential; low strength.	Severe: slow permeability.	Slight if slope is 0 to 2 percent. Moderate if slope is 2 to 8 percent.	Severe: silty clay	Severe: silty clay
Badland: Ba	Severe: steep and very steep.	Severe: steep and very steep.	Severe: steep and very steep.	Severe: steep and very steep.	Severe: steep and very steep.
Banks: BkB	Severe: hazard of flooding.	Slight: hazards of flooding and ground water pollution.	Severe: hazard of flooding; moderately rapid permeability; hazard of ground water pollution.	Severe: hazards of flooding and ground water pollution.	Severe: hazard of flooding.
Beaverton. Mapped only with Turner soils.	Moderate: moderate frost action potential in upper 10 to 20 inches; slight frost action potential below 10 to 20 inches.	Slight: hazard of ground water pollution.	Severe: gravelly sand below a depth of 10 to 20 inches; very rapid permeability; hazard of ground water pollution.	Severe: gravelly sand below a depth of 10 to 20 inches; hazard of ground water pollution.	Severe: gravelly sand below a depth of 10 to 20 inches; cutbanks cave.
*Benz: BmB, BnC. For Trembles part of BnC, see Trembles series.	Severe: hazard of flooding.	Severe: slow permeability; hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.	Moderate: hazard of flooding; clay loam.
Blanchard. Mapped only with Lambert soils.	Moderate if slope is 8 to 15 percent. Severe if slope is 15 to 25 percent: hazard of ground water pollution.	Moderate if slope is 8 to 15 percent: rapid permeability. Severe if slope is 15 to 25 percent: rapid permeability; hazard of ground water pollution.	Severe: slope is 8 to 25 percent; rapid permeability; hazard of ground water pollution.	Moderate: slope is 8 to 25 percent; loamy fine sand; hazard of ground water pollution.	Severe: slope is 8 to 25 percent; loamy fine sand.
Bowbells: BoB	Moderate: moderate frost action potential; low strength.	Severe: moderately slow permeability.	Slight if slope is less than 2 percent. Moderate if slope is 2 to 4 percent.	Moderate: clay loam.	Moderate: clay loam.
*Cherry: CeA, CeB, CeC	Moderate: moderate frost action potential; moderate shrink-swell potential.	Severe: moderately slow permeability.	Slight if slope is 0 to 2 percent. Moderate if slope is 2 to 8 percent.	Moderate: silty clay loam.	Slight
Ch. For Havrelon and Trembles part, see HaA in Havrelon series and Trembles series.	Severe: hazard of flooding.	Severe: hazards of flooding and ground water pollution.	Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.

for community development and recreation

The soils in such mapping units can have different properties and limitations, and for this reason it is necessary to refer to other indicated]

Community development (cont.)		Recreation facilities			
Lawns and landscaping	Local roads and streets	Camp areas	Playgrounds	Picnic areas	Paths and trails
Severe: strongly alkaline or very strongly alkaline; silty clay.	Severe: high shrink-swell potential; low shear strength.	Severe: slow permeability; silty clay.	Severe if slope is 0 to 8 percent: slow permeability; silty clay.	Severe: slow permeability; silty clay.	Severe: silty clay.
Severe: steep and very steep.	Severe: steep and very steep.	Severe: steep and very steep.	Severe: steep and very steep.	Severe: steep and very steep.	Severe: steep and very steep.
Severe: loamy fine sand; hazard of flooding.	Severe: hazard of flooding.	Severe: loamy fine sand; hazard of soil blowing; hazard of flooding.	Severe: loamy fine sand; hazard of soil blowing; hazard of flooding.	Moderate: loamy fine sand; hazard of flooding.	Moderate: loamy fine sand.
Slight	Moderate: moderate frost action potential in upper 10 to 20 inches; slight frost action potential below 10 to 20 inches.	Slight	Slight if slope is 0 to 2 percent. Moderate if slope 2 to 4 percent.	Slight	Slight.
Severe: strongly alkaline; hazard of flooding.	Severe: hazard of flooding; low shear strength.	Moderate: clay loam; hazard of flooding.	Moderate if slope is 0 to 6 percent, severe if more than 6 percent: clay loam; hazard of flooding.	Moderate: clay loam; hazard of flooding.	Moderate: clay loam.
Moderate if slope is 8 to 15 percent: loamy fine sand. Severe if slope is 15 to 25 percent.	Moderate if slope is 8 to 15 percent. Severe if slope is 15 to 25 percent.	Moderate if slope is 8 to 15 percent: loamy fine sand. Severe if slope is 15 to 25 percent.	Severe: slope is 8 to 25 percent.	Moderate if slope is 8 to 15 percent: loamy fine sand. Severe if slope is 15 to 25 percent.	Moderate: slope is 8 to 25 percent; loamy fine sand.
Slight	Severe: low strength.	Moderate: moderately slow permeability.	Moderate if slope is 2 to 4 percent: moderately slow permeability.	Slight	Slight.
Moderate: silty clay loam.	Severe: low strength	Moderate: silty clay loam; moderately slow permeability.	Moderate if slope is 0 to 6 percent, severe if slope is 6 to 8 percent: silty clay loam; moderately slow permeability.	Moderate: silty clay loam.	Moderate: silty clay loam.
Severe: hazard of flooding.	Severe: hazard of flooding; moderately low strength.	Severe: hazard of flooding.	Severe: hazard of flooding.	Moderate: silty clay loam; hazard of flooding.	Moderate: silty clay loam; hazard of flooding.

TABLE 6.—*Degree and kind of limitation*

Soil series and map symbols	Community development				
	Dwellings	Septic tank absorption fields	Sewage lagoons	Sanitary landfill (trench)	Shallow excavations
*Dast: DbD. For Blanchard part, see Blanchard series.	Severe: slope is 8 to 25 percent.	Severe: slope is 8 to 25 percent; soft sandstone bedrock at a depth of 20 to 40 inches; hazard of ground water pollution.	Severe: slope is 8 to 25 percent; moderately rapid permeability; soft sandstone bedrock at a depth of 20 to 40 inches; hazard of ground water pollution.	Severe: moderately rapid permeability; soft sandstone bedrock at a depth of 20 to 40 inches; hazard of ground water pollution.	Moderate if slope is 8 to 15 percent: soft sandstone bedrock at a depth of 20 to 40 inches. Severe if slope is 15 to 25 percent.
Dimyaw: DmD	Severe: slope is 8 to 25 percent; high shrink-swell potential.	Severe: slope is 8 to 25 percent; slow permeability.	Severe: slope is 8 to 25 percent.	Moderate: slope is 8 to 25 percent; silty clay loam.	Moderate if slope is 8 to 15 percent. Severe if slope is 15 to 25 percent.
Dooley: DoB	Moderate: moderate frost action potential; moderate shrink-swell potential.	Severe: moderately slow permeability below a depth of 20 inches.	Moderate: slope is 2 to 6 percent; moderately slow permeability in upper 20 to 40 inches.	Moderate: clay loam below a depth of 20 inches.	Moderate: clay loam below a depth of 20 inches.
Farnuf: FaA, FaB	Moderate: moderate frost action potential; moderate shrink-swell potential.	Moderate: moderate permeability.	Moderate: moderate permeability.	Moderate: clay loam	Moderate: clay loam
Havrelon:					
HaA	Severe: hazard of flooding.	Severe: hazards of flooding and ground water pollution.	Severe: hazards of flooding and ground water pollution.	Severe: hazards of flooding and ground water pollution.	Severe: hazard of flooding.
HaB	Severe: hazard of flooding.	Severe: hazards of flooding and ground water pollution.	Severe: hazards of flooding and ground water pollution.	Severe: hazard of flooding.	Moderate: hazard of flooding.
Hb	Severe: hazard of flooding.	Severe: hazards of flooding and ground water pollution.	Severe: hazards of flooding and ground water pollution.	Severe: hazards of flooding and ground water pollution.	Severe: hazard of flooding.
Hoffmanville: Ho	Severe: hazard of flooding.	Severe: hazards of flooding and ground water pollution.	Severe: hazard of flooding; moderately rapid permeability below a depth of 20 to 40 inches; hazard of ground water pollution.	Severe; hazard of flooding; moderately rapid permeability below a depth of 20 to 40 inches; hazard of ground water pollution.	Severe: hazard of flooding; silty clay at a depth of 20 to 40 inches; loamy fine sand below.
*Lambert:					
LaE	Severe: slope is 15 to 40 percent.	Severe: slope is 15 to 40 percent; moderately slow permeability.	Severe: slope is 15 to 40 percent.	Moderate if slope is 15 to 25 percent. Severe if slope is 25 to 40 percent.	Severe: slope is 15 to 40 percent.
LbC	Moderate: moderate frost action potential.	Severe: moderately slow permeability.	Moderate: slope is 2 to 8 percent.	Slight	Slight
LbD	Moderate: slope is 8 to 15 percent; moderate frost action potential.	Severe: moderately slow permeability.	Severe: slope is 8 to 15 percent.	Slight: slope is 8 to 15 percent.	Moderate: slope is 8 to 15 percent.

for community development and recreation—Continued

Community development (cont.)		Recreation facilities			
Lawns and landscaping	Local roads and streets	Camp areas	Playgrounds	Picnic areas	Paths and trails
Severe: slope is 8 to 25 percent; soft sandstone bedrock at a depth of 20 to 40 inches; hazard of ground water pollution.	Moderate if slope is 8 to 15 percent: soft sandstone bedrock at a depth of 20 to 40 inches; moderate frost action potential. Severe if slope is 15 to 25 percent.	Moderate if slope is 8 to 15 percent. Severe if slope is 15 to 25 percent.	Severe: slope is 8 to 25 percent.	Moderate if slope is 8 to 15 percent. Severe if slope is 15 to 25 percent.	Slight if slope is 8 to 15 percent. Moderate if slope is 15 to 25 percent.
Moderate if slope is 8 to 15 percent: silty clay loam. Severe if slope is 15 to 25 percent.	Severe: slope is 8 to 25 percent.	Severe if slope is 15 to 25 percent: slow permeability.	Severe: slope is 8 to 25 percent.	Moderate if slope is 8 to 15 percent: silty clay loam. Severe if slope is 15 to 25 percent.	Moderate: slope is 8 to 25 percent; silty clay loam.
Slight	Moderate: moderate frost action potential; moderate shrink-swell potential.	Slight	Moderate: slope is 2 to 6 percent.	Slight	Slight.
Moderate: clay loam	Moderate: moderate frost action potential; moderate shrink-swell potential.	Slight	Slight if slope is 0 to 2 percent, moderate if slope is 2 to 4 percent.	Slight	Slight.
Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.	Slight: hazard of flooding.	Slight.
Slight: hazard of flooding.	Severe: hazard of flooding.	Slight	Slight if slope is 1 to 2 percent, moderate if slope is 2 to 4 percent.	Slight: hazard of flooding.	Slight.
Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.	Moderate: silty clay loam; hazard of flooding.	Moderate: silty clay loam.
Severe: hazard of flooding; silty clay.	Severe: hazard of flooding.	Severe: hazard of flooding; silty clay.	Severe: hazard of flooding; silty clay.	Severe: silty clay; hazard of flooding.	Severe: silty clay.
Severe: slope is 15 to 40 percent.	Severe: slope is 15 to 40 percent.	Severe: slope is 15 to 40 percent.	Severe: slope is 15 to 40 percent.	Severe: slope is 15 to 40 percent.	Moderate if slope is 15 to 25 percent. Severe if slope is 25 to 40 percent.
Slight	Moderate: moderate frost action potential.	Moderate: moderately slow permeability.	Moderate if slope is 2 to 6 percent; moderately slow permeability. Severe if slope is 6 to 8 percent.	Slight	Slight.
Moderate: slope is 8 to 15 percent.	Moderate: slope is 8 to 15 percent; moderate frost action potential.	Moderate: slope is 8 to 15 percent; moderately slow permeability.	Severe: slope is 8 to to 25 percent.	Moderate: slope is 8 to 15 percent.	Slight: slope is 8 to 15 percent.

TABLE 6.—*Degree and kind of limitation*

Soil series and map symbols	Community development				
	Dwellings	Septic tank absorption fields	Sewage lagoons	Sanitary landfill (trench)	Shallow excavations
Lc. For Badland part, see Badland.	Severe: steep.	Severe: steep; moderately slow permeability.	Severe: steep.	Severe: steep.	Severe: steep.
LeD. For Blanchard part, see Blanchard series.	Moderate if slope is 8 to 15 percent: moderate frost action potential. Severe if slope is 15 to 25 percent.	Severe: slope is 8 to 25 percent; moderately slow permeability.	Severe: slope is 8 to 25 percent.	Slight if slope is 8 to 15 percent. Moderate if slope is 15 to 25 percent.	Moderate if slope is 8 to 15 percent. Severe if slope is 15 to 25 percent.
LfF, LhF. For Dimyaw part of LfF, see Dimyaw series; for Ringling part of LhF, see Ringling series.	Severe: slope is 15 to 65 percent.	Severe: slope is 15 to 65 percent; moderately slow permeability.	Severe: slope is 15 to 65 percent.	Moderate if slope is 15 to 25 percent. Severe if slope is 25 to 65 percent.	Severe: slope is 15 to 65 percent.
Lihen: LmD.	Slight if slope is 4 to 8 percent. Moderate if slope is 8 to 15 percent.	Slight if slope is 4 to 8 percent. Moderate if slope is 8 to 15 percent.	Severe: slope is 8 to 15 percent; rapid permeability.	Severe: rapid permeability; hazard of ground water pollution.	Severe: loamy fine sand; cutbanks cave.
Lohler:					
Lo.	Severe: hazard of flooding; high shrink-swell potential.	Severe: moderately slow permeability; hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.
Lp.	Severe: hazard of flooding; high shrink-swell potential.	Severe: moderately slow permeability; hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.
Lw.	Severe: hazard of flooding; high shrink-swell potential; wet.	Severe: wet; moderately slow permeability; hazard of flooding.	Severe: wet; hazard of flooding.	Severe: wet; hazard of flooding.	Severe: wet; hazard of flooding.
Marias: Ma.	Severe: high shrink-swell potential.	Severe: very slow permeability.	Slight.	Severe: silty clay.	Severe: silty clay.
Ridgelawn: Rd.	Severe: hazard of flooding.	Severe: hazards of flooding and ground water pollution.	Severe: hazard of flooding; rapid permeability at a depth of 20 to 40 inches; hazard of ground water pollution.	Severe: hazard of flooding; rapid permeability at a depth of 20 to 40 inches; hazard of ground water pollution.	Severe: hazard of flooding; fine sand at a depth of 20 to 40 inches.
Ringling. Mapped only with Lambert soils.	Severe: slope is 15 to 65 percent.	Severe: slope is 15 to 65 percent.	Severe: slope is 15 to 65 percent; very rapid permeability; hazard of ground water pollution.	Severe: slope is 15 to 65 percent; cobbles and gravel at a depth of 10 to 20 inches; very rapid permeability; hazard of ground water pollution.	Severe: slope is 15 to 65 percent; cobbles and gravel at a depth of 10 to 20 inches.
Riverwash: Rw.	Severe: hazard of flooding.	Severe: hazards of flooding and ground water pollution.	Severe: hazards of flooding and ground water pollution.	Severe: hazard of flooding; rapid permeability; hazard of ground water pollution.	Severe: hazard of flooding.

for community development and recreation—Continued

Community development (cont.)		Recreation facilities			
Lawns and landscaping	Local roads and streets	Camp areas	Playgrounds	Picnic areas	Paths and trails
Severe: steep.	Severe: steep.	Severe: steep.	Severe: steep.	Severe: steep.	Severe: steep.
Moderate if slope is 8 to 15 percent. Severe if slope is 15 to 25 percent.	Moderate if slope is 8 to 15 percent: moderate frost action potential. Severe if slope is 15 to 25 percent.	Moderate if slope is 8 to 15 percent. Severe if slope is 15 to 25 percent.	Severe: slope is 8 to 25 percent.	Moderate if slope is 8 to 15 percent. Severe if slope is 15 to 25 percent.	Slight if slope is 8 to 15 percent. Moderate if slope is 15 to 25 percent.
Severe: slope is 15 to 65 percent.	Severe: slope is 15 to 65 percent.	Severe: slope is 15 to 65 percent.	Severe: slope is 15 to 65 percent.	Severe: slope is 15 to 65 percent.	Severe: slope is 15 to 65 percent.
Severe: loamy fine sand.	Moderate: slopes of 8 to 15 percent.	Moderate: slopes of 8 to 15 percent; loamy fine sand.	Moderate if slope is 4 to 6 percent. Severe if slope is 6 to 15 percent.	Moderate: slopes of 8 to 15 percent; loamy fine sand.	Moderate: loamy fine sand.
Moderate: silty clay loam.	Severe: hazard of flooding; high shrink-swell potential.	Moderate: silty clay loam; hazard of flooding.	Moderate: silty clay loam; hazard of flooding.	Moderate: silty clay loam; hazard of flooding.	Moderate: silty clay loam.
Severe: clay; hazard of flooding.	Severe: hazard of flooding; high shrink-swell potential.	Severe: clay; hazard of flooding.	Severe: clay; hazard of flooding.	Severe: clay; hazard of flooding.	Severe: clay.
Severe: wet; clay; hazard of flooding.	Severe: wet; hazard of flooding; high shrink-swell potential.	Severe: wet; clay; hazard of flooding.	Severe: wet; clay; hazard of flooding.	Severe: wet; clay; hazard of flooding.	Severe: wet; clay.
Severe: silty clay	Severe: high shrink-swell potential.	Severe: silty clay.	Severe: silty clay.	Severe: silty clay.	Severe: silty clay.
Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.	Slight: hazard of flooding.	Slight.
Severe: slope is 15 to 65 percent.	Severe: slope is 15 to 65 percent.	Severe: slope is 15 to 65 percent.	Severe: slope is 15 to 65 percent.	Severe: slope is 15 to 65 percent.	Moderate if slope is 15 to 25 percent. Severe if slope is 25 to 65 percent.
Severe: hazard of flooding; sand and gravel.	Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.

TABLE 6.—*Degree and kind of limitation*

Soil series and map symbols	Community development				
	Dwellings	Septic tank absorption fields	Sewage lagoons	Sanitary landfill (trench)	Shallow excavations
Savage:					
SaA	Severe: high shrink-swell potential.	Severe: moderately slow permeability.	Slight.	Moderate: silty clay loam.	Slight.
SaB	Severe: high shrink-swell potential.	Severe: moderately slow permeability.	Moderate: slope is 2 to 4 percent.	Moderate: silty clay loam.	Slight.
*Shambo:					
ShA	Moderate: moderate frost action potential.	Moderate: moderate permeability.	Moderate: moderate permeability.	Slight.	Slight.
ShB, ShC, SmC. For Lambert part of SmC, see LbC in Lambert series.	Moderate: moderate frost action potential.	Moderate: moderate permeability.	Moderate: slope is 2 to 8 percent; moderate permeability.	Slight.	Slight.
SmD. For Lambert part, see LbD in Lambert series.	Moderate: slope is 8 to 15 percent; moderate frost action potential.	Moderate: slope is 8 to 15 percent; moderate permeability.	Severe: slope is 8 to 15 percent.	Slight.	Moderate: slope is 8 to 15 percent.
Strip mines, reclaimed: St. No estimate made because properties are too variable; onsite investigation needed.					
Tally:					
TaA, TaB	Moderate: moderate frost action potential.	Slight: hazard of ground water pollution.	Severe: moderately rapid permeability; hazard of ground water pollution.	Severe: moderately rapid permeability; hazard of ground water pollution.	Moderate: fine sandy loam; cutbanks cave.
TaC	Moderate: moderate frost action potential.	Slight if slope is 4 to 8 percent: hazard of ground water pollution.	Severe: slope; moderately rapid permeability; hazard of ground water pollution.	Severe: moderately rapid permeability; hazard of ground water pollution.	Moderate: slope is 8 to 12 percent; fine sandy loam; cutbanks cave.
Tinsley: TeF	Severe: slope is 15 to 65 percent.	Severe: slope is 15 to 65 percent.	Severe: slope is 15 to 65 percent; rapid permeability.	Severe: slope is 15 to 65 percent; rapid permeability.	Severe: slope is 15 to 65 percent; cutbanks cave; gravelly sand.
Trembles: Tm	Severe: hazard of flooding.	Severe: hazard of flooding and gound water pollution.	Severe: hazard of flooding; moderately rapid permeability; hazard of ground water pollution.	Severe: hazard of flooding; moderately rapid permeability; hazard of ground water pollution.	Severe: hazard of flooding.
Turner: ToB. For Beaverton part, see Beaverton series.	Moderate: moderate frost action potential to a depth of 20 to 40 inches; low frost action potential below.	Slight: hazard of ground water pollution.	Severe: rapid permeability in sand and gravel substrata below a depth of 20 to 40 inches; hazard of ground water pollution.	Severe: rapid permeability in sand and gravel substrata below a depth of 20 to 40 inches; hazard of ground water pollution.	Severe: sand and gravel substrata below a depth of 20 to 40 inches; cutbanks cave.

for community development and recreation—Continued

Community development (cont.)		Recreation facilities			
Lawns and landscaping	Local roads and streets	Camp areas	Playgrounds	Picnic areas	Paths and trails
Moderate: silty clay loam.	Severe: high shrink-swell potential.	Moderate: silty clay loam; moderately slow permeability.	Moderate: silty clay loam; moderately slow permeability.	Moderate: silty clay loam.	Moderate: silty clay loam.
Moderate: silty clay loam.	Severe: high shrink-swell potential.	Moderate: silty clay loam; moderately slow permeability.	Moderate: slope is 2 to 4 percent; silty clay loam; moderately slow permeability.	Moderate: silty clay loam.	Moderate: silty clay loam.
Slight.	Moderate: moderate frost action potential.	Slight.	Slight.	Slight.	Slight.
Slight.	Moderate: moderate frost action potential.	Slight.	Moderate if slope is 2 to 4 percent. Severe if slope is 4 to 8 percent.	Slight.	Slight.
Moderate: slope is 8 to 15 percent.	Moderate: slope is 8 to 15 percent; moderate frost action potential.	Moderate: slope is 8 to 15 percent.	Severe: slope is 8 to 15 percent.	Moderate: slope is 8 to 15 percent.	Slight.
Slight.	Moderate: moderate frost action potential.	Slight.	Slight if slope is 0 to 2 percent. Moderate if slope is 2 to 4 percent.	Slight.	Slight.
Slight if slope is 4 to 8 percent. Moderate if slope is 8 to 12 percent.	Moderate: moderate frost action potential.	Slight if slope is 4 to 8 percent. Moderate if slope is 8 to 12 percent.	Moderate if slope is 4 to 6 percent. Severe if slope is 6 to 12 percent.	Slight if slope is 4 to 8 percent. Moderate if slope is 8 to 12 percent.	Slight.
Severe: slope is 15 to 65 percent; more than 50 percent coarse fragments on the surface.	Severe: slope is 15 to 65 percent.	Severe: slope is 15 to 65 percent; more than 50 percent coarse fragments on the surface.	Severe: slope is 15 to 65 percent; more than 50 percent coarse fragments on the surface.	Severe: slope is 15 to 65 percent; more than 50 percent coarse fragments on the surface.	Severe: slope is 25 to 65 percent; more than 50 percent coarse fragments on the surface.
Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.	Slight: hazard of flooding.	Slight.
Slight: sand and gravel below a depth of 20 inches.	Moderate: moderate frost action potential to a depth of 20 to 40 inches; low frost action potential below.	Slight.	Slight if slope is 0 to 2 percent. Moderate if slope is 2 to 4 percent.	Slight.	Slight.

TABLE 6.—*Degree and kind of limitation*

Soil series and map symbols	Community development				
	Dwellings	Septic tank absorption fields	Sewage lagoons	Sanitary landfill (trench)	Shallow excavations
Typic Haplaquents: Tw. No estimates because properties are too variable; onsite investigation needed.					
Vanda: Va	Severe: high shrink-swell potential.	Severe: very slow permeability.	Slight if slope is 0 to 2 percent. Moderate if slope is 2 to 4 percent.	Severe: clay	Severe: clay
*Vida:					
VdB	Moderate; moderate frost action potential; moderate shrink-swell potential; low strength.	Severe: moderately slow permeability.	Slight if slope is 1 to 2 percent. Moderate if slope is 2 to 4 percent.	Moderate: clay loam	Moderate: clay loam
VdC	Moderate: moderate frost action potential; moderate shrink-swell potential; low strength.	Severe: moderately slow permeability.	Moderate: slope is 4 to 8 percent.	Moderate: clay loam	Moderate: clay loam
VhC. For Zahill part, see Zahill series.	Moderate: moderate frost action potential; moderate shrink-swell potential; low strength.	Severe: moderately slow permeability.	Moderate: slope is 4 to 8 percent.	Moderate: clay loam	Moderate: clay loam
VhD. For Zahill part, see Zahill series.	Moderate: moderate frost action potential; moderate shrink-swell potential; low. strength.	Severe: moderately slow permeability.	Severe: slope is 8 to 15 percent.	Moderate: clay loam	Moderate: slope is 8 to 15 percent; clay loam.
Williams: WmB	Moderate: moderate frost action potential; moderate shrink-swell potential; low strength.	Severe: moderately slow permeability.	Slight if slope is 0 to 2 percent. Moderate if slope is 2 to 4 percent.	Moderate: clay loam	Moderate: clay loam
*Zahill:					
Zahill part of units VhC and VhD.	Moderate: moderate frost action potential; moderate shrink-swell potential; low strength.	Severe: moderately slow permeability.	Moderate if slope is 4 to 8 percent. Severe if slope is 8 to 15 percent.	Moderate: clay loam.	Moderate: slope is 4 to 15 percent; clay loam.
ZaF, ZbF. For Lambert part of ZbF, see LhF in Lambert series.	Severe: slope is 15 to 65 percent.	Severe: slope is 15 to 65 percent; moderately slow permeability.	Severe: slope is 15 to 65 percent.	Moderate if slope is 15 to 25 percent. Severe if slope is 25 to 65 percent.	Severe: slope is 15 to 65 percent.

low the surface layer and in fragipans or other layers that restrict movement of water; amount of water held available to plants; and need for drainage, or depth to a water table or bedrock.

Terraces and diversions are embankments, or ridges, constructed across the slope to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock or to other unfavorable material; presence of stones; permeability; resistance to water erosion, soil slipping, and soil blowing; and availability of outlets for runoff. Establishing a plant cover on such a soil is not difficult.

Grassed waterways are sodded areas used to convey water and thus protect the soils against erosion.

for community development and recreation—Continued

Community development (cont.)		Recreation facilities			
Lawns and landscaping	Local roads and streets	Camp areas	Playgrounds	Picnic areas	Paths and trails
Severe: clay; strongly alkaline.	Severe: high shrink-swell potential.	Severe: clay	Severe: clay	Severe: clay	Severe: clay.
Moderate: clay loam	Severe: low strength.	Moderate: clay loam; moderately slow permeability.	Moderate: slope is 1 to 4 percent; clay loam; moderately slow permeability.	Moderate: clay loam.	Moderate: clay loam.
Moderate: clay loam	Severe: low strength.	Moderate: clay loam; moderately slow permeability.	Moderate if slope is 4 to 6 percent: clay loam; moderately slow permeability. Severe if slope is 6 to 8 percent.	Moderate: clay loam	Moderate: clay loam.
Moderate: clay loam	Severe: low strength.	Moderate: clay loam	Severe: slope is 4 to 8 percent.	Moderate: clay loam	Moderate: clay loam.
Moderate: slope is 8 to 15 percent; clay loam.	Severe: frost action potential; low strength.	Moderate: slope is 8 to 15 percent; clay loam; moderately slow permeability.	Severe: slope is 8 to 15 percent.	Moderate: slope is 8 to 15 percent; clay loam.	Moderate: clay loam.
Slight	Severe: low strength.	Moderate: moderately slow permeability.	Moderate: slope is 0 to 4 percent; moderately slow permeability.	Slight	Slight.
Slight if slope is 4 to 8 percent. Moderate if slope is 8 to 15 percent.	Severe: low strength.	Moderate: slope is 4 to 15 percent; moderately slow permeability.	Moderate if slope is 4 to 6 percent: moderately slow permeability. Severe if slope is 6 to 15 percent.	Slight if slope is 4 to 8 percent. Moderate if slope is 8 to 15 percent.	Slight.
Severe: slope is 15 to 65 percent.	Severe: slope is 15 to 65 percent.	Severe: slope is 15 to 65 percent.	Severe: slope is 15 to 65 percent.	Severe: slope is 15 to 65 percent.	Moderate if slope is 15 to 25 percent. Severe if slope is 25 to 65 percent.

County planning and recreation

The estimated interpretations in table 6 are based on the engineering properties of soils shown in table 4, on test data for soils in this survey area and in other areas nearby or adjoining, and on the experience of engineers and soil scientists with the soils of Richland County. In table 6, ratings are used to summarize limitations of soils for dwellings, septic tank absorption fields, sewage lagoons, sanitary landfill, shallow excavations, lawns, local streets and roads, camp areas, playgrounds, picnic areas, and paths and trails.

Soil limitations given in table 6 are indicated by the ratings *slight, moderate,* and *severe. Slight* means soil properties are generally favorable for the rated use or, in other words, the limitations are minor and easily overcome. *Moderate* means that some soil

properties are unfavorable but they can be overcome or modified by special planning and design. *Severe* means soil properties are so unfavorable or so difficult to correct or overcome that they require major soil reclamation, special design, or intensive maintenance.

Following are explanations of the column headings in table 6.

Dwellings, as rated in table 6, are not more than 3 stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to capacity to support load and resist settlement under load, and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material from a depth of 24 inches to 6 feet is evaluated. The soil properties considered are those that affect absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope affects layout and construction and the risk of erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet long enough for bacteria to decompose the solids. A lagoon has a nearly level floor; its sides, or embankments, are of soil material compacted to medium density; and the pond is protected from flooding. Properties that affect the pond floor are permeability, organic matter content, and slope, and if the floor needs to be leveled, depth to bedrock becomes important. The soil properties that affect the embankment are the engineering properties of the embankment material as interpreted from the Unified soil classification system and the content of stones, which influences the ease of excavation and compaction of embankment material.

Sanitary landfill is a method of disposing of refuse in dug trenches. The waste is spread in thin layers, compacted, and covered with soil. Landfill areas are subject to heavy vehicular traffic. Soil properties that affect suitability for landfill are ease of excavation, hazard of polluting ground water, and trafficability. The best soils have moderately slow permeability, can withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated, the ratings in table 6 apply only to the soil material to a depth of about 6 feet, so a limitation of *slight* or *moderate* may not be valid if trenches are to be deeper. For some soils, reliable predictions can be made to a depth of 10 or 15 feet; nevertheless, every site should be investigated before it is selected.

Shallow excavations are those that require digging or trenching to a depth of less than 6 feet, for example, excavations for pipelines, sewer lines, phone and power transmission lines, basements, open ditches, and cemeteries. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or big stones, freedom from flooding, and absence of a high water table.

Lawns and landscaping are affected by such properties as alkalinity, permeability, available water capacity, flooding, high water table, and texture. Desirable soil properties are gentle slopes, moderate permeability, loamy texture, high available water capacity, and freedom from flooding or a high water table.

Local roads and streets, as rated in table 6, have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep.

Soil properties that most affect design and construction of roads and streets are load-supporting capacity and stability of the subgrade and the workability and quantity of cut and fill material available. The AASHTO and Unified classifications of the soil material and the shrink-swell potential indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and the amount of cut and fill needed to reach an even grade.

Camp areas are used intensively for tents and small camp trailers and the accompanying activities of outdoor living. Little preparation of the site is required, other than shaping and leveling for tent and parking areas. Camp areas are subject to heavy foot traffic and limited vehicular traffic. The best soils have mild slopes, good drainage, and a surface free of rocks and coarse fragments, and they are not subject to flooding during periods of heavy use. Their surface is firm after rain but not dusty when dry.

Playgrounds are areas used intensively for baseball, football, badminton, and similar organized games. Soils that are suitable for this use need to withstand intensive foot traffic. The best soils have a nearly level surface free of coarse fragments and rock outcrops. They have good drainage and are not subject to flooding during periods of heavy use. Their surface is firm after rain but not dusty when dry. If grading and leveling are required, depth to rock is important.

Picnic areas are attractive natural or landscaped tracts that carry heavy foot traffic. Most of the vehicular traffic, however, is confined to access roads. The best soils are firm when wet but not dusty when dry, are not subject to flooding during the season of use, and do not have slopes or stones that can greatly increase the cost of leveling or of building access roads.

Paths and trails are used for local and cross-country travel on foot or horseback. Design and layout should require little or no cutting and filling. The best soils

are at least moderately well drained, are firm when wet but not dusty when dry, are flooded not more than once during the season of use, have slopes of less than 15 percent, and have few or no rocks or stones on the surface.

Formation, morphology, and classification

This section has three main parts. The first part discusses the major factors of soil formation as they relate to the formation of soils in Richland County. The second part discusses the morphology of soils. The third part describes the system for classifying soils, and places the soils in the system.

Formation

Soil is a natural body on the surface of the earth in which plants grow. It consists mainly of mineral material and some organic material. Soils differ in their appearance, composition, productivity, and management requirements in different localities or even within short distances in the same locality. The factors that cause soils to differ are: (1) the physical and chemical composition of the parent material; (2) the climate under which the soil material has accumulated and existed since accumulation; (3) the biological forces; (4) the relief, or lay of the land; and (5) the length of time that forces of formation have acted on the soil material.

The relative importance of each factor differs from place to place, but generally the interaction of all the factors determines the kind of soil that forms in any given place. The influence of each soil-forming factor on the soils in Richland County is described in the following pages.

Parent material

Parent material is the weathered rock or unconsolidated material in which soil forms. The hardness, grain size, and porosity of the parent material and its content of weatherable minerals greatly influence the formation of soils. The three sources of parent material in Richland County are glacial till, sedimentary beds, and alluvium.

The soils of greatest extent in the county are those that formed in glacial till. The clay loam material containing a random distribution of rock fragments was deposited over underlying sedimentary beds during the Wisconsin Glaciation or earlier. Bowbells, Vida, Williams, and Zahill soils formed in glacial till.

Soils that formed in material weathered from the unconsolidated Tongue River member of the Fort Union Formation also make up large areas of the county. These include Lambert and Shambo soils that formed in material weathered from the silty beds; the Dimyaw soil that formed in material weathered from the clayey beds; the Dast soil that formed in material weathered from the weakly consolidated sandstone; and the Ringling soil that formed in material weathered from the red shale, or "scoria," beds in the formation. Blanchard soils formed in wind- and water-reworked materials weathered from weakly consolidated sandstone.

Areas of Badland in Richland County were derived from exposures of the Fort Union and Lebo Formations. These areas form the rough breaks along the Yellowstone and Missouri Rivers.

Adger soils formed on fans and terraces in glacial till overlying gray clays of the Lebo Formation, which is mainly in the northwest corner of the county.

Alluvium is the parent material in which the greatest variety of soils formed. Beaverton, Farnuf, Savage, Turner, and Tinsley soils formed in alluvium on high benches that are remnants of old terraces of the Yellowstone River. Dooley, Lihen, and Tally soils formed in alluvium, or aeolian material derived from alluvium, that mantles parts of the uplands in the county. Banks, Benz, Havrelon, Hoffmanville, Lohler, Marias, Ridgelawn, Trembles, and Vanda soils formed in recent alluvium on young terraces and flood plains of the rivers and their tributaries. Banks soils formed in sandy alluvium on low terraces and flood plains. Trembles, Havrelon, and Ridgelawn soils formed in loamy alluvium. Hoffmanville, Lohler, and Marias soils formed in clayey alluvium. Benz and Vanda soils formed in loamy and clayey alluvium that contains appreciable quantities of sodium.

Cherry soils formed in silty materials locally derived from the soft sedimentary beds. They are mainly on alluvial fans.

Climate

The climate of the survey area is characterized by cold winters, warm summers, and low annual precipitation. Presumably, it is similar to the climate under which the soils formed.

The cold, dry climate tends to retard soil formation. Temperature is low enough much of the time to slow the rates of chemical reaction and biological activity that cause most of the weathering of minerals. The remains of plants decompose slowly. Small amounts of water from normal precipitation move into the soil to translocate carbonates, as is evident from the accumulations of carbonates at shallow depths in most soils. Leaching is interrupted by the soils freezing to a depth of 3 feet or more for 3 or 4 months in most years.

The climate is fairly uniform throughout the county, although precipitation is slightly higher in the northern and western parts of the county than in other parts. Most climatic data for the county are given in the section "General nature of the county."

Biological forces

Plants, animals, insects, bacteria, and fungi are important in the formation of soils. They change the amount of organic matter and nitrogen in the soil, the amount of plant nutrients, and soil structure and porosity.

Plants generally have a greater effect on soil formation than do other living organisms. Grass is the dominant vegetation in the county. The native range supports a very complex plant community consisting

of numerous grass species and a variety of forbs and shrubs. Some native woodlands are in the stream valleys. Cottonwood, willows, and green ash are the principal species. Thin stands of scrubby ponderosa pine and Rocky Mountain juniper are on some rough and broken land. Low precipitation limits the amount of plant material that is produced, but low temperatures favor the accumulation of organic matter. Most soils have at least a thin surface layer that is darkened by organic matter; some are darkened to a depth of several inches.

Relief

Relief, or lay of the land, has been a major factor of soil formation in Richland County. The landscape consists mainly of nearly level to rolling uplands in which a few remnants of nearly level to undulating old stream terraces or benches are a few hundred feet higher than the present stream valleys. Valley bottoms of the major streams—the Missouri, Yellowstone, and Redwater Rivers and their larger tributaries—range in width from a few hundred yards to about 3 miles. The various terraces in these valleys range from nearly level to sloping and are separated by obscure to prominent escarpments. Along the valley walls geologic erosion has produced a steep to very steep landscape that varies in width from a few hundred yards to as much as a few miles. Many areas are marked by a series of slumps, giving the slopes a stepped appearance. In other areas the slopes are smooth and rounded. Most areas are stabilized by a grass cover, but some are nearly barren, severely eroded Badland. Prominent areas of Badland occur along the Missouri River breaks to the north of Sidney and along the east side of the Yellowstone River.

Relief is such that the soils in the county are well drained to excessively drained, except for a few areas on the flood plains of small streams and in a few upland swales.

The influence of relief on soil formation in Richland County is best illustrated by the comparison of Vida, Williams, and Zahill soils. These soils formed in glacial till that is relatively uniform in all visible characteristics and can be assumed to have a common origin and to have been deposited at about the same time. Williams soils, mainly on the nearly level to gently undulating part of the plain, have a dark grayish brown loam surface layer underlain by a grayish brown clay loam subsoil in which the carbonates are leached to a depth of about 21 inches. Vida soils, on the gently undulating to rolling part of the plain, have a surface layer and subsoil that are leached of carbonates to a depth of not more than 9 inches. Zahill soils, on the crests of low ridges, on the plain, and at the steep to very steep edges of the plain, show no evidence of soil formation other than a surface layer of dark grayish brown loam 4 inches thick that is still calcareous. Relief has been the major factor in forming these soils, through its influence on runoff and erosion. Williams soils have the lowest relief and the least amount of runoff. As a result the normal precipitation enters the soil and leaches carbonates to the greatest depth. Vida soils have intermediate relief, and some of the precipitation runs off, resulting in carbonates being leached to a shallower depth. Also, some material is undoubtedly eroded from the surface layer of Vida soils and deposited on the surface layer of Williams soils downslope. Zahill soils, on the steepest slopes, have the most runoff and show little evidence of leaching and marked evidence of erosion.

Time

The effect of time on soil formation is best illustrated by a comparison of the Farnuf and Havrelon soils, both of which formed in loamy alluvium. Farnuf soils are on the highest and oldest terraces in the stream valleys and on some of the high benches which are remnants of old stream terraces. These soils have a dark grayish brown surface layer, a subsoil that has distinct structure and illuviated clay, and carbonates leached to a depth of about 15 inches. Havrelon soils are on the lower and youngest terraces in the stream valley and formed in recent alluvium. They have a light brownish gray to grayish brown surface layer, they lack a developed subsoil, and they are calcareous throughout the profile.

Morphology

This section defines the terms used to name soil horizons, and it discusses how soil horizons develop.

The characteristics produced by soil-forming processes are recorded in the soil profile, which is a vertical cross section of the soil through all of its horizons, or layers. The horizons differ in one or more properties such as color, texture, structure, consistence, porosity, and reaction.

Most soil profiles contain three main horizons: the A horizon, the B horizon, and the C horizon. These major horizons may be subdivided in some soil profiles.

The A horizon is the surface layer. Where it is the horizon of maximum organic matter content, it is called the A1 horizon; and the horizon of maximum leaching of dissolved or suspended materials is called the A2 horizon. The symbol Ap denotes a plowed layer.

The B horizon, or subsoil, lies immediately beneath the A horizon. It contains maximum accumulation of dissolved or suspended materials such as iron or clay. The B horizon generally is firmer than the horizons immediately above and below it, and it commonly has a blocky or prismatic structure. The B horizon is undeveloped in young soils.

The C horizon, or parent material, is affected relatively little by the soil-forming processes, but it can be modified by weathering.

Other symbols added to the A, B, and C horizons denote specific features. The symbol "ca" denotes an accumulation of carbonates, commonly of calcium. The symbol "cs" denotes an accumulation of gypsum. The suffix "t" added to B, as in B2t, indicates accumulations of translocated silicate clay.

The processes involved in the formation of soil horizons in Richland County have been the accumulation of organic matter, the leaching of calcium carbonates and more soluble salts, and the formation and trans-

location of silicate clay minerals. In most soils, more than one of these processes has affected horizon development.

The accumulation of organic matter in the upper part of the profile has been sufficient to form a darkened A1 horizon in most soils in Richland County. In some places the A1 horizon is only 2 inches thick, but in other places it is as much as 16 inches thick. The amount of accumulated organic matter varies considerably.

The low annual precipitation limits the leaching of carbonates in most of the soils in the county. In some soils, lime has been leached from the A horizon and the upper part of the B horizon and has accumulated in distinct layers at a depth of about 8 to 30 inches. In only a few soils, lime has been leached to a depth of more than 30 inches. Many of the young soils are calcareous throughout and lack distinct horizons of lime accumulation.

Formation of clay by chemical weathering of clay forming minerals and their translocation has contributed to horizon development in some soils. But in most of the soils that have accumulations of translocated clays, the amounts are not large. Clay films in pores and on ped faces are evidence that a soil has a B2t horizon.

Classification

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationships to one another and to the whole environment, and to develop principles that help us understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*3*) and later revised (*5*). The system currently used was adopted by the National Cooperative Soil Survey in 1965 (*4*) and supplemented in March, 1967; September, 1968; and April, 1969 (*7*). Because this system is under continual study, readers interested in development of the current system should search the latest literature available.

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen so that the soils of similar genesis, or mode of origin, are grouped. In table 7, the soil series of Richland County are placed in four categories of the current system. Categories of the current system are briefly defined in the following paragraphs.

TABLE 7.—*Soil series classified according to the current system of classification*

Series	Family	Subgroup	Order
Adger	Fine, montmorillonitic	Typic Natriborolls	Mollisols.
Banks	Sandy, mixed, frigid	Typic Ustifluvents	Entisols.
Beaverton	Loamy-skeletal, mixed	Typic Argiborolls	Mollisols.
Benz	Fine-loamy, mixed (calcareous), frigid	Ustic Torrifluvents	Entisols.
Blanchard	Mixed, frigid	Typic Ustipsamments	Entisols.
Bowbells	Fine-loamy, mixed	Pachic Argiborolls	Mollisols.
Cherry	Fine-silty, mixed, frigid	Typic Ustochrepts	Inceptisols.
Dast	Coarse-loamy, mixed (calcareous), frigid	Typic Ustorthents	Entisols.
Dimyaw	Fine, montmorillonitic (calcareous), frigid	Typic Ustorthents	Entisols.
Dooley	Fine-loamy, mixed	Typic Argiborolls	Mollisols.
Farnuf	Fine-loamy, mixed	Typic Argiborolls	Mollisols.
Havrelon	Fine-loamy, mixed (calcareous), frigid	Typic Ustifluvents	Entisols.
Hoffmanville	Clayey over sandy or sandy-skeletal, montmorillonitic (calcareous), frigid.	Typic Ustifluvents	Entisols.
Lambert	Fine-silty, mixed (calcareous), frigid	Typic Ustorthents	Entisols.
Lihen	Sandy, mixed	Entic Haploborolls	Mollisols.
Lohler	Fine, montmorillonitic (calcareous), frigid	Typic Ustifluvents	Entisols.
Marias	Fine, montmorillonitic (calcareous), frigid	Ustertic Torriorthents	Entisols.
Ridgelawn	Fine-loamy over sandy or sandy-skeletal, mixed (calcareous), frigid.	Typic Ustifluvents	Entisols.
Ringling	Fragmental, mixed	Typic Haploborolls	Mollisols.
Savage	Fine, montmorillonitic	Typic Argiborolls	Mollisols
Shambo	Fine-loamy, mixed	Typic Haploborolls	Mollisols.
Tally	Coarse-loamy, mixed	Typic Haploborolls	Mollisols.
Tinsley	Sandy-skeletal, mixed, frigid	Typic Ustorthents	Entisols.
Trembles	Coarse-loamy, mixed (calcareous), frigid	Typic Ustifluvents	Entisols.
Turner	Fine-loamy over sandy or sandy-skeletal, mixed	Typic Argiborolls	Mollisols.
Vanda	Fine, montmorillonitic (calcareous), frigid	Ustic Torriorthents	Entisols.
Vida	Fine-loamy, mixed	Typic Argiborolls	Mollisols.
Williams	Fine-loamy, mixed	Typic Argiborolls	Mollisols.
Zahill	Fine-loamy, mixed (calcareous), frigid	Typic Ustorthents	Entisols.

ORDER. Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groups of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different climates. Each order is named with a word of three or four syllables ending in sol (Ent-i-sol).

SUBORDER. Each order is divided into suborders that are based primarily on those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation. The names of suborders have two syllables. The last syllable indicates the order. An example is Fluvent (*Fluv,* meaning produced by a river, and *ent,* from Entisol).

GREAT GROUP. Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequences of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated; those that have pans that interfere with growth of roots, movement of water, or both; and thick, dark colored surface layers. The features used are the self-mulching properties of clay; soil temperature; major differences in chemical composition, mainly calcium, magnesium, sodium, and potassium; dark red and dark brown colors associated with basic rocks; and similar features. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is Ustifluvents (*Usti* implying dryness, *fluv* for river deposit, and *ent* from Entisols).

SUBGROUP. Great groups are divided into subgroups, one representing the central (typic) segment of the group, and others called intergrades that have properties of the group and one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is *Typic Ustifluvents* (a typical Ustifluvent).

FAMILY. Soil families are separated within a subgroup primarily on the basis of properties important to the growth of plants or on the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and so on, that are used as family differentiae (see table 7). An example is the coarse-loamy, mixed (calcareous), frigid family of Typic Ustifluvents.

General nature of the county

This section discusses the physiography and drainage, climate, natural resources, settlement and farming, and industry and transportation of the county. Statistics for population and agriculture are from reports by the U.S. Bureau of the Census and the Department of Agriculture.

Physiography and drainage

Richland County is on the glaciated and sedimentary plains of the eastern part of Montana. The western and northern areas of Richland County are drained by the Redwater and Missouri Rivers. The southeastern and eastern areas are drained by the Yellowstone River.

Elevation ranges from about 1,800 feet on the flood plain of the Yellowstone and Missouri Rivers at the northeastern corner of the county to 2,900 feet along the divide between the drainageways of the Yellowstone and Redwater Rivers.

Richland County is characterized by undulating to rolling uplands; large, nearly level upland benches; and steep breaks. Areas of excessive relief occur along steep, north- and west-facing erosional fronts of the Yellowstone-Redwater divide and in the breaks from the uplands along the Yellowstone and Missouri Rivers. In these areas there are local differences of a few hundred feet.

Climate

The climate of Richland County generally can be described as continental, with cold winters, warm summers, and marked variation in seasonal precipitation. Table 8 shows temperature and precipitation data recorded at Sidney, Montana. Table 9 shows maximum rainfall intensities estimated from technical papers prepared by the National Weather Service. Table 10 gives the probabilities of the last freezing temperatures in spring and the first in fall. Precipitation averages 13 to 14 inches annually in the Yellowstone Valley and 13 to 15 inches in the uplands. However, in a normal year about 80 percent of the annual precipitation falls during the April-to-September growing season. June is generally the wettest month, followed by May and July, which have about equal amounts of rainfall.

Winter snowfall is generally not heavy. It averages about 30 inches annually in the Yellowstone Valley, with slightly greater amounts in the uplands. Although snowfall averages are not large compared to the rest of Montana, heavy snow does occur infrequently, generally late in winter or early in spring. Summer precipitation usually occurs as showers, and summer thundershowers are fairly frequent. Some of these thundershowers occasionally produce hail heavy enough to damage crops. Hail falls at least once somewhere within the county just about every year. Steady, gentle rains lasting from several hours to more than 24 hours can occur in May, June, and September.

Winters are quite cold, although not as severe as many believe. Some very cold spells can occur each winter, but they do not ordinarily last for an extended period of time. About once in every 9 or 10 years, the

average temperature in January or February is below zero. Relatively mild weather in winter is not uncommon; however, periods of mild weather do not occur as frequently during winter in Richland County as in counties nearer to the Rocky Mountains. In spring the change from wintry to warmer weather is quite rapid, and the progressive cooling of fall is very noticeable during October and November.

Summers are characterized by warm weather which often lasts for weeks at a time. Sunny weather prevails during summer, as sunshine averages about 70 to 80 percent of the amount possible. Showers and thundershowers occur mostly during the afternoons. A few days of hot weather occur almost every year, but hot spells seldom last more than a few days and generally are not accompanied by high humidity. Temperatures can reach a high of 90° F or more from May to September, and on about half of the afternoons in July and August temperatures will reach 90° and warmer. The average length of the growing season, between the last occurrence of 32° temperatures in spring and the first in fall, varies from 120 to 130 days in the Yellowstone Valley to about 110 days in the uplands.

Winds strong enough to cause some erosion occur almost every month. Winds are generally stronger and more frequent in spring when winds average more than 20 miles per hour about 15 percent of the time. Windspeeds of 50 miles an hour or more are occasionally part of weather systems crossing Montana in fall and winter and sometimes occur during thunderstorms in summer. The strongest winds generally come from the west.

Local flash flooding caused by sudden heavy thunderstorms can occur somewhere in the county about every 2 or 3 years. A more general type of flooding, caused by ice jams, can occur late in winter, following a cold spell. This type of flooding tends to occur at bridges, shallows, and other places where ice can become lodged and pile up.

Natural resources

The soil is the most important natural resource of Richland County. It provides the economic base for the county through crops and livestock produced on the numerous farms and ranches.

Oil and coal are important resources. The oil-producing areas are located primarily in the northeastern part of the survey area.

The county is underlain by coal, which is estimated to be about a two billion ton reserve. The coal is mined from an open pit west of the town of Savage and is used to generate electricity at a plant southeast of Sidney.

The Yellowstone River is a primary source of water for irrigation, industry, and recreation. Water for domestic uses in town and on farms and ranches mostly comes from deep wells.

Antelope, white-tailed deer, and mule deer are the big game hunting resources. Sharp-tailed grouse, gray partridge, sage grouse, and ring-necked pheasant are the principal birds. Catfish, goldeye, ling, pike, and paddlefish are in the Missouri and Yellowstone Rivers. Many ponds are stocked with bass, bluegill, northern pike, perch, and rainbow trout.

Moss agate can be found on gravel bars along dry creeks and the Yellowstone River.

Settlement and farming

Fur trappers and traders were the first settlers in the lower part of the Yellowstone Valley. In the early 1870's, cattlemen from the west brought large cattle herds to graze the open prairies. Later, horse and sheep outfits made their headquarters here. About 54 percent of the county is still used as rangeland. It is grazed by cattle, sheep, and wildlife.

The homesteaders moved into this area in large numbers between 1906 and 1925, converting large areas of nearly level benches and undulating rolling uplands into dryland grain farms. About 421,000 acres are in wheat, barley, and oats. These crops are dryfarmed and used mainly in rotation with a year of fallow. A small acreage is used for legume-grass hay and for flax and safflower.

Irrigation of native hay meadows along the Yellowstone River began early in the 1900's. A low dam across this river at Intake, in Dawson County, diverts water into the Lower Yellowstone Project Canal that serves the west side of the river valley. The State Water Resources Board project irrigates several thousand acres on the east side of the river. Privately-owned pumping systems furnish water for several thousand more acres on the east side of the Yellowstone Valley and south of the Missouri River. About 46,301 acres of irrigated cropland and hayland are in the county. The principal irrigated crops are sugar beets, alfalfa hay, corn grown for silage, and potatoes. Cereal grains and beans are irrigated on a few thousand acres.

Most of the acreage in Richland County is privately owned and operated. The Burlington-Northern Railroad owns 36,067 acres, most of which is used by farmers and ranchers on a cash-lease basis. The State of Montana owns sections 16 and 36, called school sections, in most townships, and leases these to farmers and ranchers. Federally owned grazing land, about 54,000 acres in scattered sections, is used by ranchers who hold grazing permits from the Bureau of Land Management.

In 1970, the population of Richland County was 9,837. Sidney, the county seat, had a population of 4,543; Fairview, the only other incorporated town, had 956; and the unincorporated town of Savage had 280 and Lambert had 102. Other communities centered around small towns were established during homesteading days, then dwindled in the 1930's. These are Andes, Burns, Crane, Enid, Mona, Nohly, and Three Buttes.

Educational facilities in the county include elementary schools and high schools in Fairview, Lambert, Savage, and Sidney; and several rural elementary schools.

TABLE 8.—*Temperature*

[Data recorded at Sidney, Montana for the

Month	Temperature				Precipitation		
	Average daily maximum	Average daily minimum	Average monthly highest maximum	Average monthly lowest minimum	Average monthly	1 year in 10 will have—	
						Less than—	More than—
	°F	°F	°F	°F	Inches	Inches	Inches
January	20	—2	46	—30	0.4	0.1	0.7
February	29	6	50	—20	.4	.1	.7
March	38	15	63	—9	.4	.1	.8
April	56	29	79	14	1.2	.2	2.4
May	68	41	88	25	1.9	.3	4.5
June	76	49	93	38	2.8	1.1	5.5
July	83	54	96	42	2.0	.4	3.6
August	83	51	96	39	1.7	.2	3.0
September	71	41	89	26	1.1	.1	2.5
October	60	31	80	15		.7	1.2
November	42	19	64	1	.4	.1	.7
December	30	7	51	—15	.3	.1	.6
Year	54	28	[2]99	[3]—33	13.3	8.6	18.5

[1] T means trace.
[2] Average annual highest maximum.
[3] Average annual lowest minimum.

TABLE 9.—*Estimated intensity and duration of maximum rainfall.*

Duration of maximum rainfall	Return periods				
	2 years	5 years	10 years	25 years	50 years
	Inches	Inches	Inches	Inches	Inches
30 minutes	0.6	0.8	1.1	1.3	1.5
1 hours	.8	1.1	1.4	1.7	2.0
2 hours	.9	1.2	1.5	1.8	2.2
3 hours	1.0	1.3	1.6	2.0	2.3
6 hours	1.1	1.5	1.8	2.2	2.6
12 hours	1.4	1.9	2.3	2.8	3.2
24 hours	1.6	2.2	2.6	3.0	3.4

Industry and transportation

Industry, other than agriculture, includes a few companies furnishing services in the oil fields in the northeastern part of the county; and Montana-Dakota Utilities Company, which has a coal-powered electricity generating plant located southeast of Sidney.

Agriculture-related industry consists of a few large feedlots and a sugar refinery. The Northern Great Plains Agricultural Research Center and the Montana Agricultural Experiment Station are also located at Sidney.

Transportation facilities include an airline, a busline, and railroads serving Fairview, Lambert, Savage, and Sidney. State Highways 200 and 201 cross from east to west. State Highway 23 begins south of Sidney and crosses east into North Dakota.

TABLE 10.—*Probability of last freezing temperatures in spring and first in fall.*

[Data recorded at Sidney, Montana]

Probability	Dates for temperatures of—		
	24° F or lower	28° F or lower	32° F or lower
Spring:			
1 year in 10 later than	May 11	May 21	June 2
2 years in 10 later than	May 7	May 17	May 28
5 years in 10 later than	April 28	May 8	May 20
Fall:			
1 year in 10 earlier than	Sept. 23	Sept. 10	Sept. 6
2 years in 10 earlier than	Sept. 27	Sept. 15	Sept. 10
5 years in 10 earlier than	Oct. 5	Sept. 23	Sept. 19

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and precipitation data
period 1949-70; elevation 1,920 feet]

Precipitation (cont.)						
2 years in 10 will have—		3 years in 10 will have—		4 years in 10 will have—		Average monthly snowfall
Less than—	More than—	Less than—	More than—	Less than—	More than—	
Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
0.2	0.6	0.3	0.5	0.3	0.3	6.9
.2	.6	.3	.4	.3	.3	5.0
.2	.6	.3	.5	.3	.4	4.4
.3	2.2	.4	1.8	.5	1.3	3.5
.8	3.0	1.1	2.5	1.4	1.9	.6
1.6	4.3	1.8	3.2	2.1	2.7	[1]T
.8	2.4	1.1	2.1	1.6	1.9	T
.4	2.7	.7	2.3	1.1	1.8	T
.3	2.2	.4	1.7	.5	.8	.2
.2	1.0	.3	.9	.5	.7	1.4
.2	.5	.2	.4	.3	.3	4.3
.2	.4	.2	.3	.3	.2	5.6
10.0	16.1	11.1	15.1	12.2	13.7	31.9

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Glossary

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, slit, or clay, deposited on land by streams.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coat, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. A delay in grazing until range plants have reached a specified stage of growth. Grazing is deferred in order to increase the vigor of forage and to allow desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the

soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Erosion. The wearing away of the land surface by running water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes a bare surface.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called normal field capacity, normal moisture capacity, or capillary capacity.

Flood plain. Nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or B horizon.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—few, common, distinct, and prominent. The size measurements are of the diameter along the greatest dimension. Fine indicates less than 5 millimeters (about 0.2 inch); medium, from 5 to 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three single variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are very slow (less than 0.06 inch), slow (0.06 to 0.20 inch),

moderately slow (0.2 to 0.6 inch), moderate (0.6 to 2.0 inches), moderately rapid (2.0 to 6.0 inches), rapid (6.0 to 20 inches), and very rapid (more than 20 inches).

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Range condition. The health or productivity of forage plants on a given range, in terms of the potential productivity under normal climate and the best practical management. Condition classes generally recognized are—excellent, good, fair, and poor. The classification is based on the percentage of original, or assumed climax vegetation on a site, as compared to what has been observed to grow on it when well managed.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH		pH
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are either single grained (each grain by itself, as in dune sand) or massive (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Underlying material. That part of the soil below the solum.

Water table. The upper limit of the soil of underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

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GUIDE TO MAPPING UNITS

Map symbol	Mapping unit	Page	Capability unit or subclass: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
AdC	Adger silty clay loam, 0 to 8 percent slopes---	7	VIe	28	------	--	Dense clay	36
Ba	Badland--	7	VIIIe	29	------	--	----------------	--
BkB	Banks loamy fine sand, 0 to 4 percent slopes---	8	IVe-2	28	IVe-1	31	Sands	33
BmB	Benz clay loam, 0 to 4 percent slopes----------	9	VIe	28	------	--	Saline Upland	36
BnC	Benz-Trembles complex, 0 to 8 percent slopes---	9	VIe	28	------	--	----------------	--
	Benz part----------------------------------	--	------	--	------	--	Saline Upland	36
	Trembles part------------------------------	--	------	--	------	--	Sandy	34
BoB	Bowbells silt loam, 0 to 4 percent slopes------	10	IIIe-2	26	------	--	Silty	34
CeA	Cherry silty clay loam, 0 to 2 percent slopes--	10	IIIc-2	27	IIc-1	30	Silty	34
CeB	Cherry silty clay loam, 2 to 4 percent slopes--	10	IIIe-2	26	IIe-1	29	Silty	34
CeC	Cherry silty clay loam, 4 to 8 percent slopes--	10	IIIe-6	27	IIIe-1	30	Silty	34
Ch	Cherry, Havrelon, and Trembles soils, occasionally flooded------------------------	10	VIw	28	------	--	Overflow	33
DbD	Dast-Blanchard complex, 8 to 25 percent slopes-	11	VIe	28	------	--	---------------	--
	Dast part----------------------------------	--	------	--	------	--	Sandy	34
	Blanchard part-----------------------------	--	------	--	------	--	Sands	33
DmD	Dimyaw silty clay loam, 8 to 25 percent slopes-	11	VIe	28	------	--	Thin Hilly	35
DoB	Dooley fine sandy loam, 2 to 6 percent slopes--	12	IIIe-4	27	------	--	Sandy	34
FaA	Farnuf loam, 0 to 2 percent slopes-------------	12	IIIc-2	27	IIc-1	30	Silty	34
FaB	Farnuf loam, 2 to 4 percent slopes-------------	12	IIIe-2	26	IIe-1	29	Silty	34
HaA	Havrelon silt loam, 0 to 1 percent slopes------	13	IIIc-2	27	IIc-1	30	Silty	34
HaB	Havrelon silt loam, 1 to 4 percent slopes------	13	IIIe-2	26	IIe-1	29	Silty	34
Hb	Havrelon silty clay loam-----------------------	13	IIIc-2	27	IIc-1	30	Clayey	35
Ho	Hoffmanville silty clay------------------------	13	IIIs-2	27	IIs-1	29	Clayey	35
LaE	Lambert gravelly loam, 15 to 40 percent slopes-	14	VIe	28	------	--	Thin Hilly	35
LbC	Lambert silt loam, 2 to 8 percent slopes-------	14	IIIe-6	27	------	--	Silty	34
LbD	Lambert silt loam, 8 to 15 percent slopes------	14	IVe-4	28	------	--	Silty	34
Lc	Lambert-Badland complex------------------------	14	VIe	28	------	--	---------------	--
	Lambert part-------------------------------	--	------	--	------	--	Thin Hilly	35
	Badland part-------------------------------	--	------	--	------	--	---------------	--
LeD	Lambert-Blanchard complex, 8 to 25 percent slopes--------------------------------------	14	VIe	28	------	--	---------------	--
	Lambert part-------------------------------	--	------	--	------	--	Thin Hilly	35
	Blanchard part-----------------------------	--	------	--	------	--	Sands	33
LfF	Lambert-Dimyaw complex, 15 to 65 percent slopes--------------------------------------	14	VIe	28	------	--	Thin Hilly	35
LhF	Lambert-Ringling complex, 15 to 65 percent slopes--------------------------------------	14	VIe	28	------	--	---------------	--
	Lambert part-------------------------------	--	------	--	------	--	Thin Hilly	35
	Ringling part------------------------------	--	------	--	------	--	Very Shallow	36
LmD	Lihen loamy fine sand, 4 to 15 percent slopes--	15	VIe	28	------	--	Sands	33
Lo	Lohler silty clay loam-------------------------	15	IIIs-4	27	IIs-3	30	Clayey	35
Lp	Lohler clay------------------------------------	15	IIIs-4	27	IIs-3	30	Dense Clay	36
Lw	Lohler clay, wet-------------------------------	15	VIw	28	------	--	Wetland	32
Ma	Marias silty clay------------------------------	16	IIIs-4	27	IIs-3	30	Clayey	35
Rd	Ridgelawn loam---------------------------------	16	IIIs-2	27	IIs-1	29	Silty	34
Rw	Riverwash--------------------------------------	17	VIIIw	29	------	--	---------------	--
SaA	Savage silty clay loam, 0 to 2 percent slopes--	17	IIIe-2	26	IIc-1	30	Clayey	35
SaB	Savage silty clay loam, 2 to 4 percent slopes--	17	IIIe-2	26	IIe-1	29	Clayey	35
ShA	Shambo loam, 0 to 2 percent slopes-------------	18	IIIc-2	27	IIc-1	30	Silty	34
ShB	Shambo loam, 2 to 4 percent slopes-------------	18	IIIe-2	26	IIe-1	29	Silty	34
ShC	Shambo loam, 4 to 8 percent slopes-------------	18	IIIe-6	27	IIIe-1	30	Silty	34
SmC	Shambo-Lambert complex, 4 to 8 percent slopes--	18	IIIe-6	27	------	--	Silty	34
SmD	Shambo-Lambert complex, 8 to 15 percent slopes-	18	IVe-4	28	------	--	Silty	34
St	Strip mines, reclaimed-------------------------	18	------	--	------	--	---------------	--
TaA	Tally fine sandy loam, 0 to 2 percent slopes---	19	IIIe-4	27	IIe-3	29	Sandy	34
TaB	Tally fine sandy loam, 2 to 4 percent slopes---	19	IIIe-4	27	IIIe-3	30	Sandy	34
TaC	Tally fine sandy loam, 4 to 12 percent slopes--	19	IVe-6	28	------	--	Sandy	34
TeF	Tinsley soils, 15 to 65 percent slopes---------	19	VIIs	28	------	--	Gravel	36
Tm	Trembles fine sandy loam-----------------------	20	IIIe-4	27	IIIe-3	30	Sandy	34

Map symbol	Mapping unit	Page	Capability unit or subclass: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site: Name	Page
ToB	Turner-Beaverton complex, 0 to 4 percent slopes-	20	IIIs-2	27	IIIe-5	30	-----------------	--
	Turner part--------------------------------	--	------	--	------	--	Silty	34
	Beaverton part-----------------------------	--	------	--	------	--	Shallow to Gravel	35
Tw	Typic Haplaquents--------------------------------	20	VIw	28	------	--	Saline Lowland	33
Va	Vanda clay--------------------------------------	21	VIe	28	------	--	Dense Clay	36
VdB	Vida clay loam, 1 to 4 percent slopes-----------	21	IIIe-2	26	------	--	Silty	34
VdC	Vida clay loam, 4 to 8 percent slopes-----------	21	IIIe-6	27	------	--	Silty	34
VhC	Vida-Zahill complex, 4 to 8 percent slopes------	21	IIIe-6	27	------	--	Silty	34
VhD	Vida-Zahill complex, 8 to 15 percent slopes-----	22	IVe-4	28	------	--	Silty	34
WmB	Williams loam, 0 to 4 percent slopes------------	22	IIIe-2	26	------	--	Silty	34
ZaF	Zahill loam, 15 to 65 percent slopes------------	23	VIe	28	------	--	Thin Hilly	35
ZbF	Zahill-Lambert complex, 15 to 65 percent slopes-	23	VIe	28	------	--	Thin Hilly	35

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SOIL ASSOCIATIONS *

SOILS ON STREAM TERRACES, FLOOD PLAINS, AND ALLUVIAL FANS

1 — Trembles-Havrelon-Lohler association: Deep, nearly level and gently sloping, well drained and moderately well drained fine sandy loams, silt loams, silty clay loams, and clays underlain by stratified fine sandy loam to silty clay alluvium; on low terraces and flood plains

2 — Cherry association: Deep, nearly level to sloping, well drained silty clay loams underlain by silt loam or silty clay loam alluvium; on alluvial fans and terraces

3 — Marias-Vanda association: Deep, nearly level and gently sloping, well drained silty clays and clays underlain by silty clay and clay alluvium; on alluvial fans and terraces

SOILS ON BENCHES, FANS, AND TERRACES ON UPLANDS

4 — Farnuf-Turner association: Deep, nearly level and gently sloping, well drained loams and clay loams underlain by clay loam alluvium or by sand and gravel; on high benches and terraces

5 — Shambo association: Deep, nearly level and gently sloping, well drained loams underlain by loam and silt loam alluvium and sedimentary beds; on fans and terraces

SOILS ON SEDIMENTARY PLAINS

6 — Dast-Blanchard association: Moderately deep and deep, undulating to rolling and hilly, well drained and excessively drained fine sandy loams and loamy fine sands underlain by soft sandstone; on uplands

7 — Shambo-Lambert association: Deep, nearly level to moderately steep, well drained loams and silt loams underlain by loam and silt loam alluvium and sedimentary beds; on uplands

8 — Lambert association: Deep, nearly level to moderately steep, well drained silt loams underlain by silt loam sedimentary beds; on uplands

9 — Shambo-Vida association: Deep, undulating to rolling and hilly, well drained loams and clay loams underlain by loam or clay loam alluvium or clay loam glacial till; on uplands

SOILS ON DISSECTED SEDIMENTARY PLAINS

10 — Lambert-Dimyaw association: Deep, steep and very steep, well drained silt loams and silty clay loams underlain by silt loam or silty clay loam and silty clay sedimentary beds; on uplands

11 — Tinsley-Lambert association: Deep, steep and very steep, well drained and excessively drained gravelly sandy loams, gravelly loamy sands, and gravelly loams underlain by gravelly sand or silt loam sedimentary beds; on uplands

12 — Badland association: Steep and very steep, severely eroded land consisting mainly of outcropping of silty, sandy, and clayey sedimentary beds; on broken uplands

SOILS ON GLACIATED PLAINS

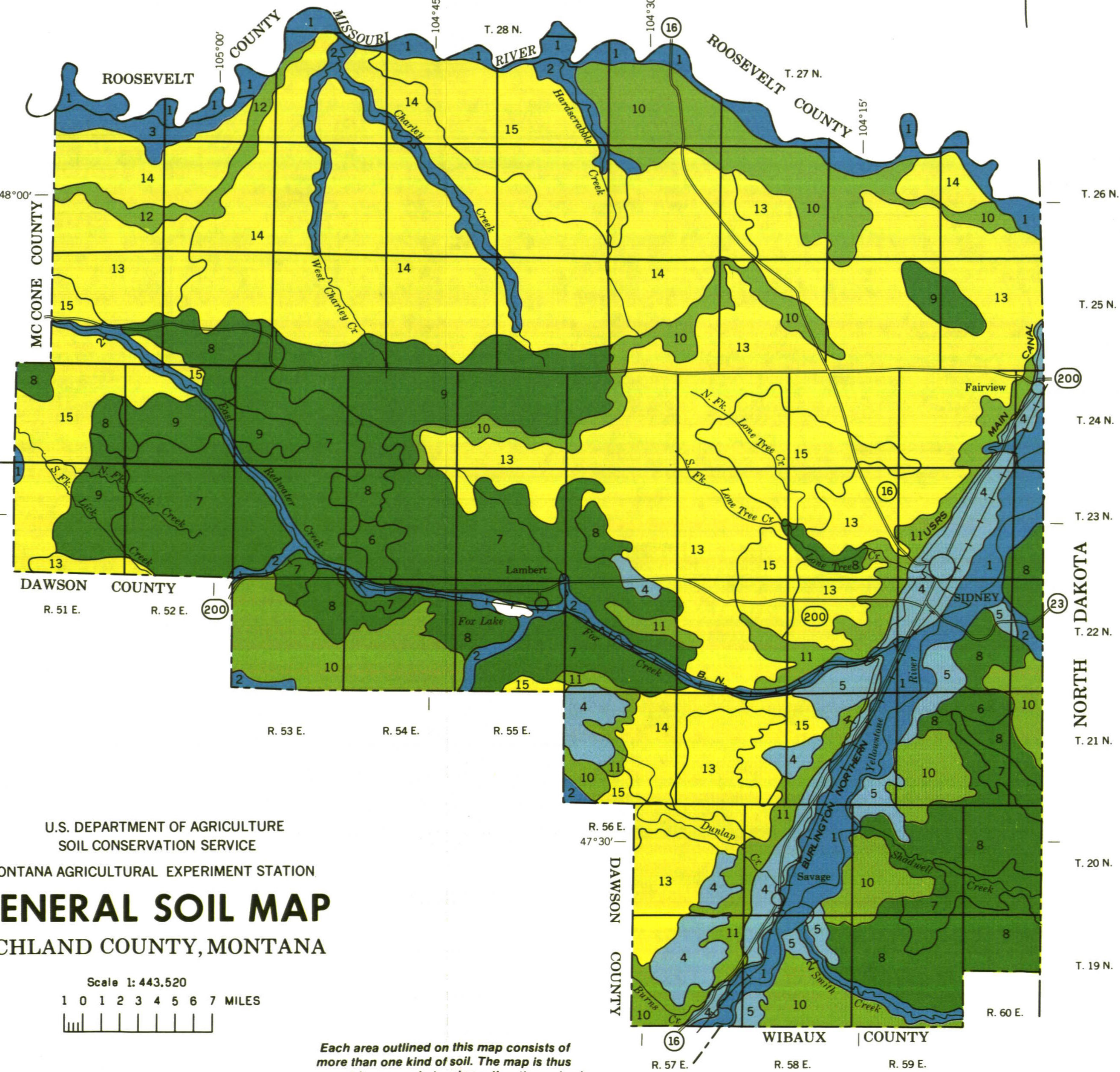
13 — Vida-Williams association: Deep, nearly level to rolling and hilly, well drained loams and clay loams underlain by clay loam glacial till; on uplands

14 — Vida-Zahill association: Deep, rolling and hilly to steep, well drained loams and clay loams underlain by clay loam glacial till; on uplands

15 — Zahill-Lambert association: Deep, moderately steep to very steep, well drained loams underlain by clay loam glacial till and silt loams underlain by silt loam sedimentary beds; on uplands

*The terms for texture used in the descriptive heading apply to the surface layer of the major soils.

Compiled 1979



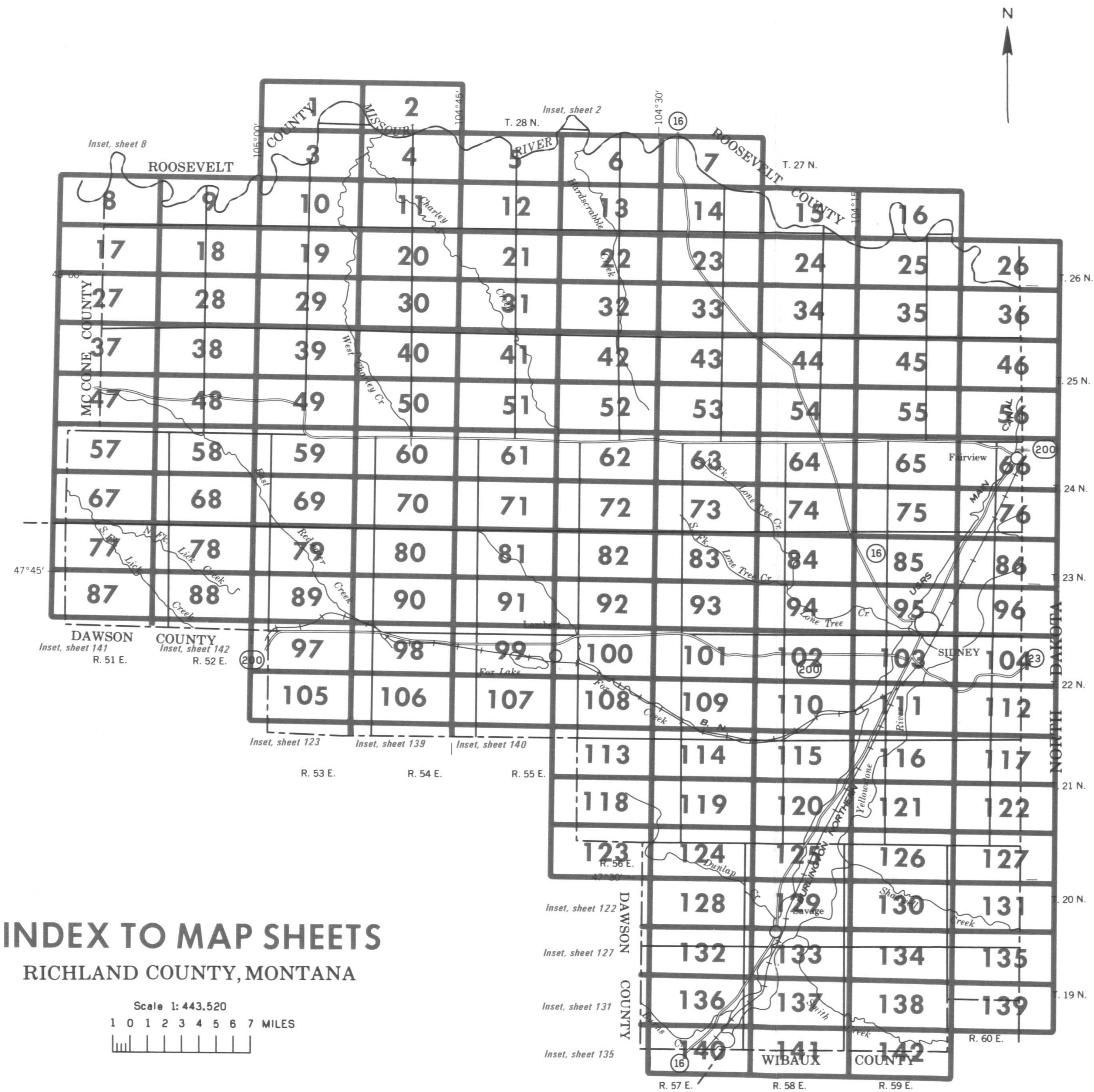
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
MONTANA AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
RICHLAND COUNTY, MONTANA

Scale 1: 443,520

1 0 1 2 3 4 5 6 7 MILES

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



INDEX TO MAP SHEETS

RICHLAND COUNTY, MONTANA

Scale 1: 443,520

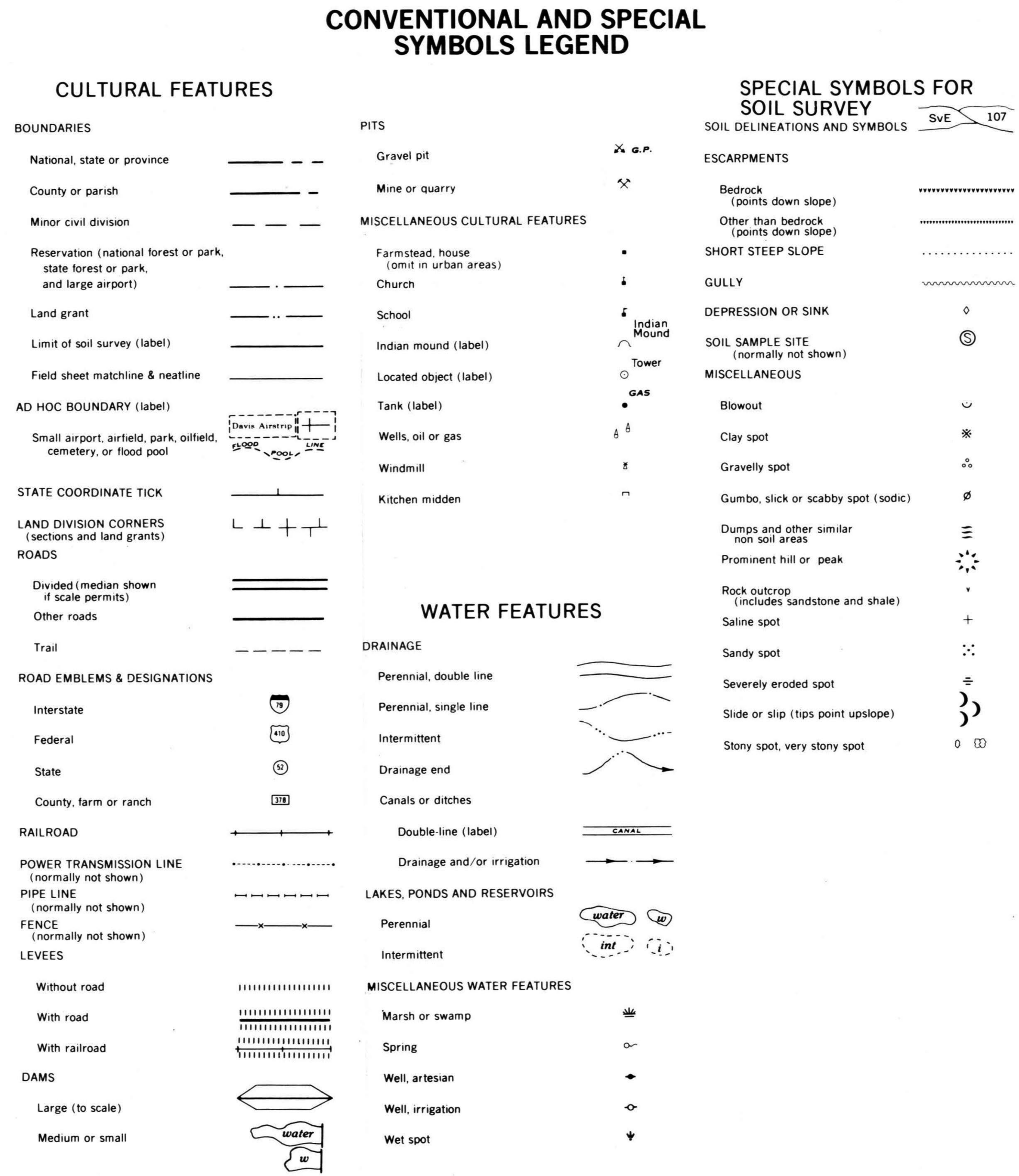
1 0 1 2 3 4 5 6 7 MILES

SOIL LEGEND

The first capital letter in the symbol is the initial one of the map unit. A second capital letter, A, B, C, D, E and F shows the slope. Most symbols without a slope letter are those for nearly level soils, but some are for land types that have considerable range in slope.

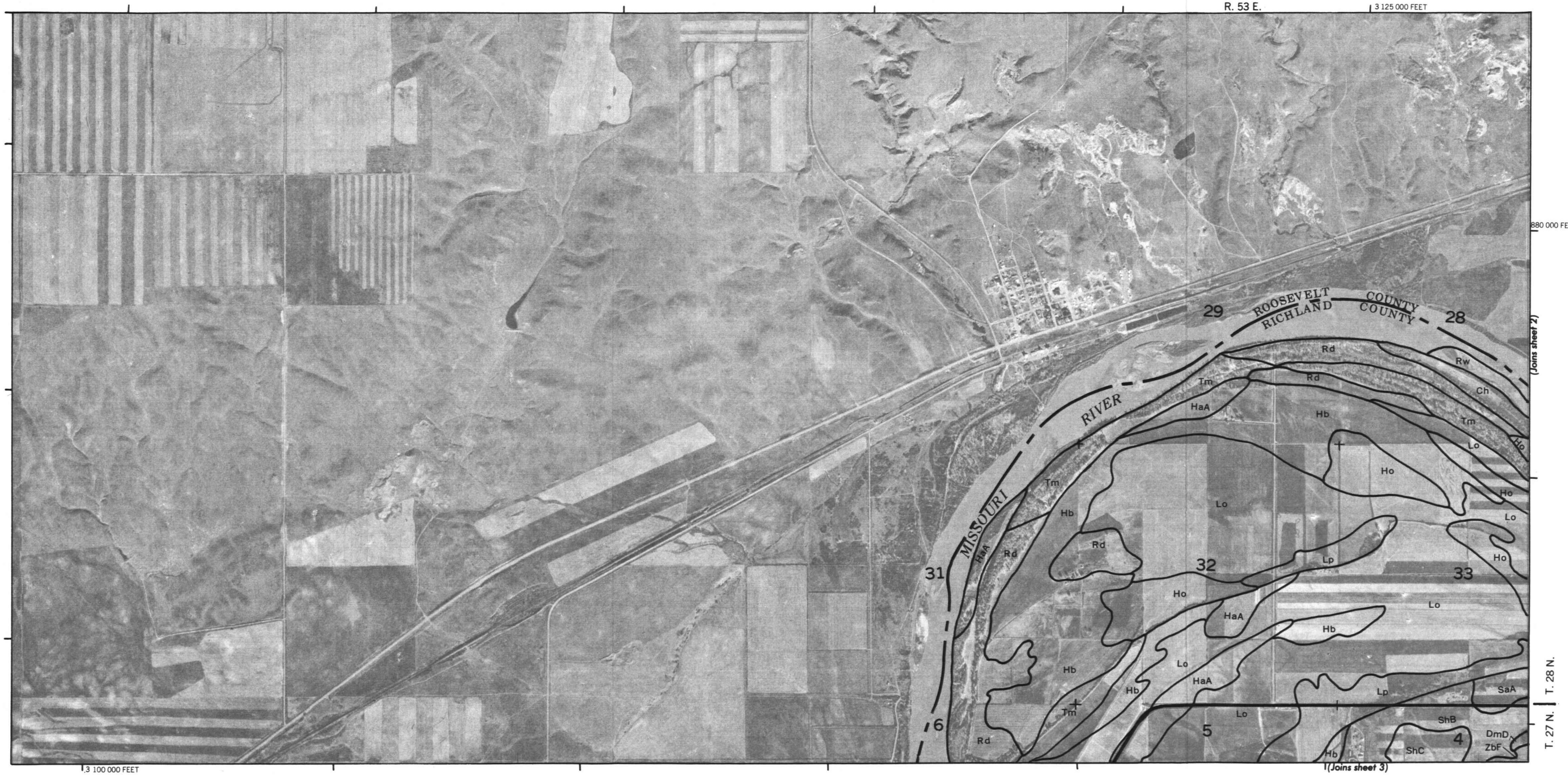
SYMBOL	NAME
AdC	Adger silty clay loam, 0 to 8 percent slopes
Ba	Badland
BkB	Banks loamy fine sand, 0 to 4 percent slopes
BmB	Benz clay loam, 0 to 4 percent slopes
BnC	Benz-Trembles complex, 0 to 8 percent slopes
BoB	Bowbells silt loam, 0 to 4 percent slopes
CeA	Cherry silty clay loam, 0 to 2 percent slopes
CeB	Cherry silty clay loam, 2 to 4 percent slopes
CeC	Cherry silty clay loam, 4 to 8 percent slopes
Ch	Cherry, Havrelon, and Trembles soils, occasionally flooded
DbD	Dast-Blanchard complex, 8 to 25 percent slopes
DmD	Dimyaw silty clay loam, 8 to 25 percent slopes
DoB	Dooley fine sandy loam, 2 to 6 percent slopes
FaA	Farnuf loam, 0 to 2 percent slopes
FaB	Farnuf loam, 2 to 4 percent slopes
HaA	Havrelon silt loam, 0 to 1 percent slopes
HaB	Havrelon silt loam, 1 to 4 percent slopes
Hb	Havrelon silty clay loam
Ho	Hoffmanville silty clay
LaE	Lambert gravelly loam, 15 to 40 percent slopes
LbC	Lambert silt loam, 2 to 8 percent slopes
LbD	Lambert silt loam, 8 to 15 percent slopes
Lc	Lambert-Badland complex
LeD	Lambert-Blanchard complex, 8 to 25 percent slopes
LfF	Lambert-Dimyaw complex, 15 to 65 percent slopes
LhF	Lambert-Ringling complex, 15 to 65 percent slopes
LmD	Lihen loamy fine sand, 4 to 15 percent slopes
Lo	Lohler silty clay loam
Lp	Lohler clay
Lw	Lohler clay, wet
Ma	Marias silty clay
Rd	Ridgelawn loam
Rw	Riverwash
SaA	Savage silty clay loam, 0 to 2 percent slopes
SaB	Savage silty clay loam, 2 to 4 percent slopes
ShA	Shambo loam, 0 to 2 percent slopes
ShB	Shambo loam, 2 to 4 percent slopes
ShC	Shambo loam, 4 to 8 percent slopes
SmC	Shambo-Lambert complex, 4 to 8 percent slopes
SmD	Shambo-Lambert complex, 8 to 15 percent slopes
St	Strip mines*
TaA	Tally fine sandy loam, 0 to 2 percent slopes
TaB	Tally fine sandy loam, 2 to 4 percent slopes
TaC	Tally fine sandy loam, 4 to 12 percent slopes
TeF	Tinsley soils, 15 to 65 percent slopes
Tm	Trembles fine sandy loam
ToB	Turner-Beaverton complex, 0 to 4 percent slopes
Tw	Typic Haplaquents
Va	Vanda clay
VdB	Vida clay loam, 1 to 4 percent slopes
VdC	Vida clay loam, 4 to 8 percent slopes
VhC	Vida-Zahill complex, 4 to 8 percent slopes
VhD	Vida-Zahill complex, 8 to 15 percent slopes
WmB	Williams loam, 0 to 4 percent slopes
ZaF	Zahill loam, 15 to 65 percent slopes
ZbF	Zahill-Lambert complex, 15 to 65 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND



RICHLAND COUNTY, MONTANA — SHEET NUMBER 1

N



Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

RICHLAND COUNTY, MONTANA NO. 1

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

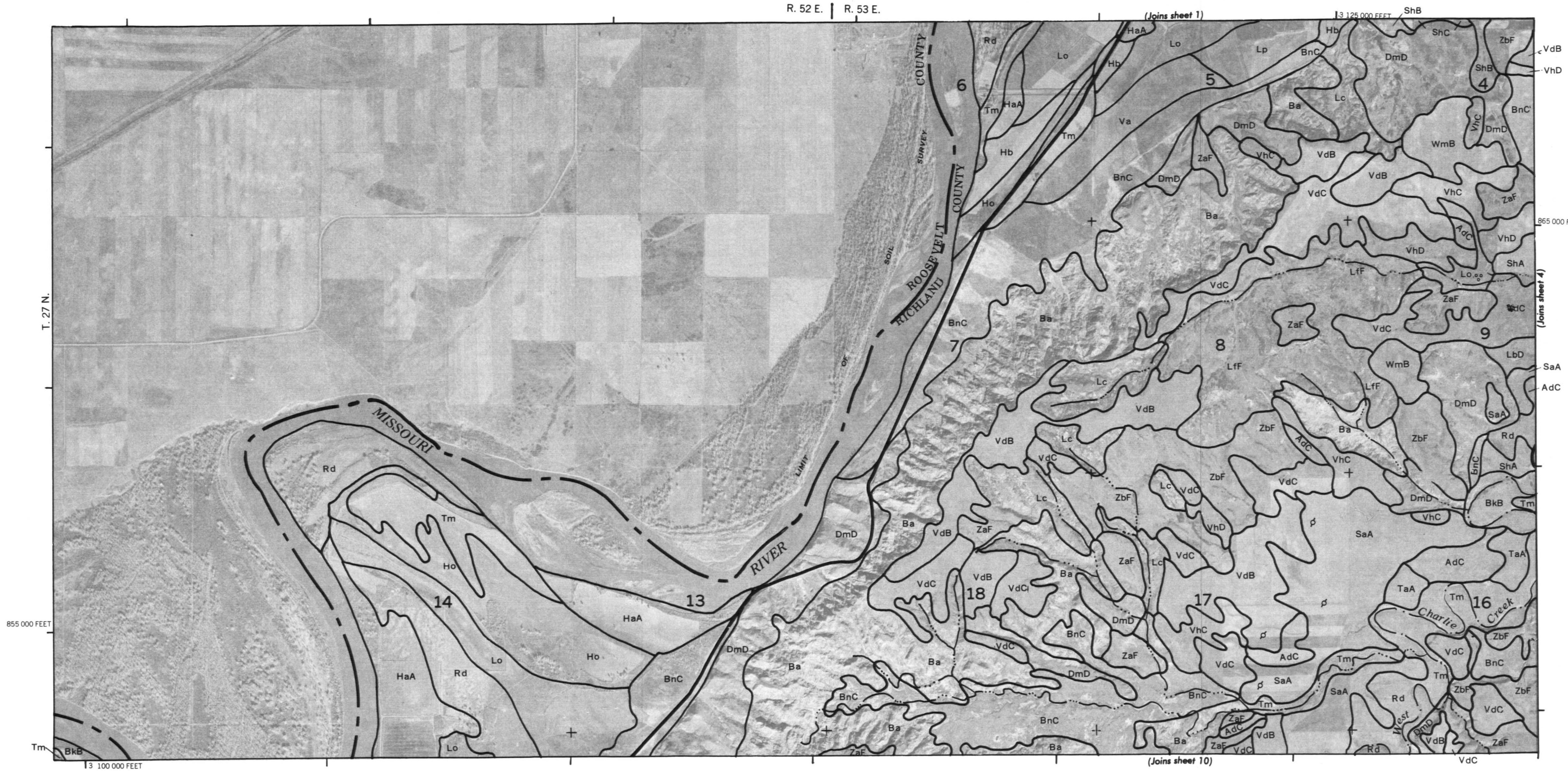
RICHLAND COUNTY, MONTANA — SHEET NUMBER 2

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

3

N



Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

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RICHLAND COUNTY, MONTANA NO. 3

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RICHLAND COUNTY, MONTANA — SHEET NUMBER 4

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RICHLAND COUNTY, MONTANA NO. 4

5

N

RICHLAND COUNTY, MONTANA NO. 5

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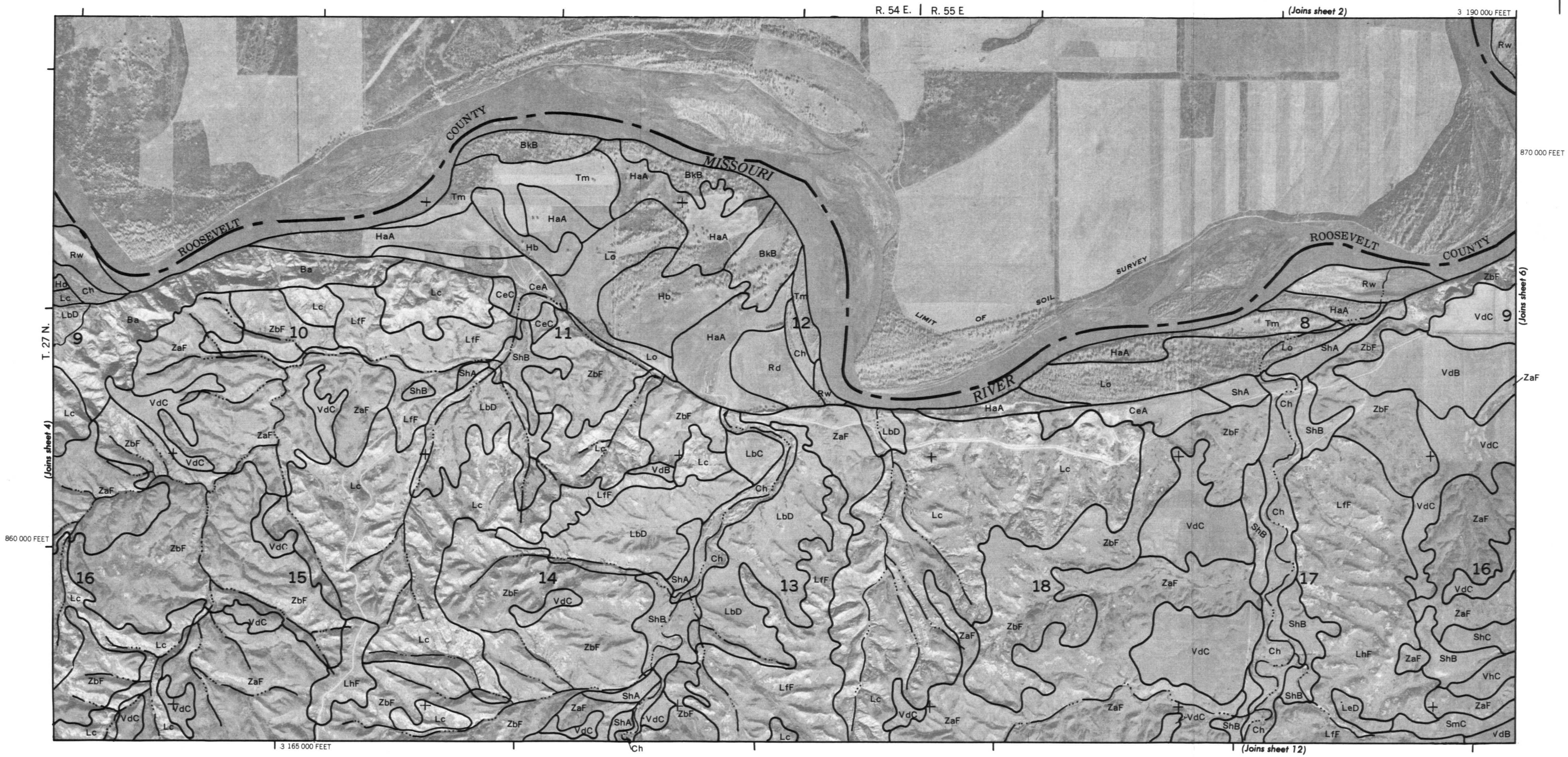

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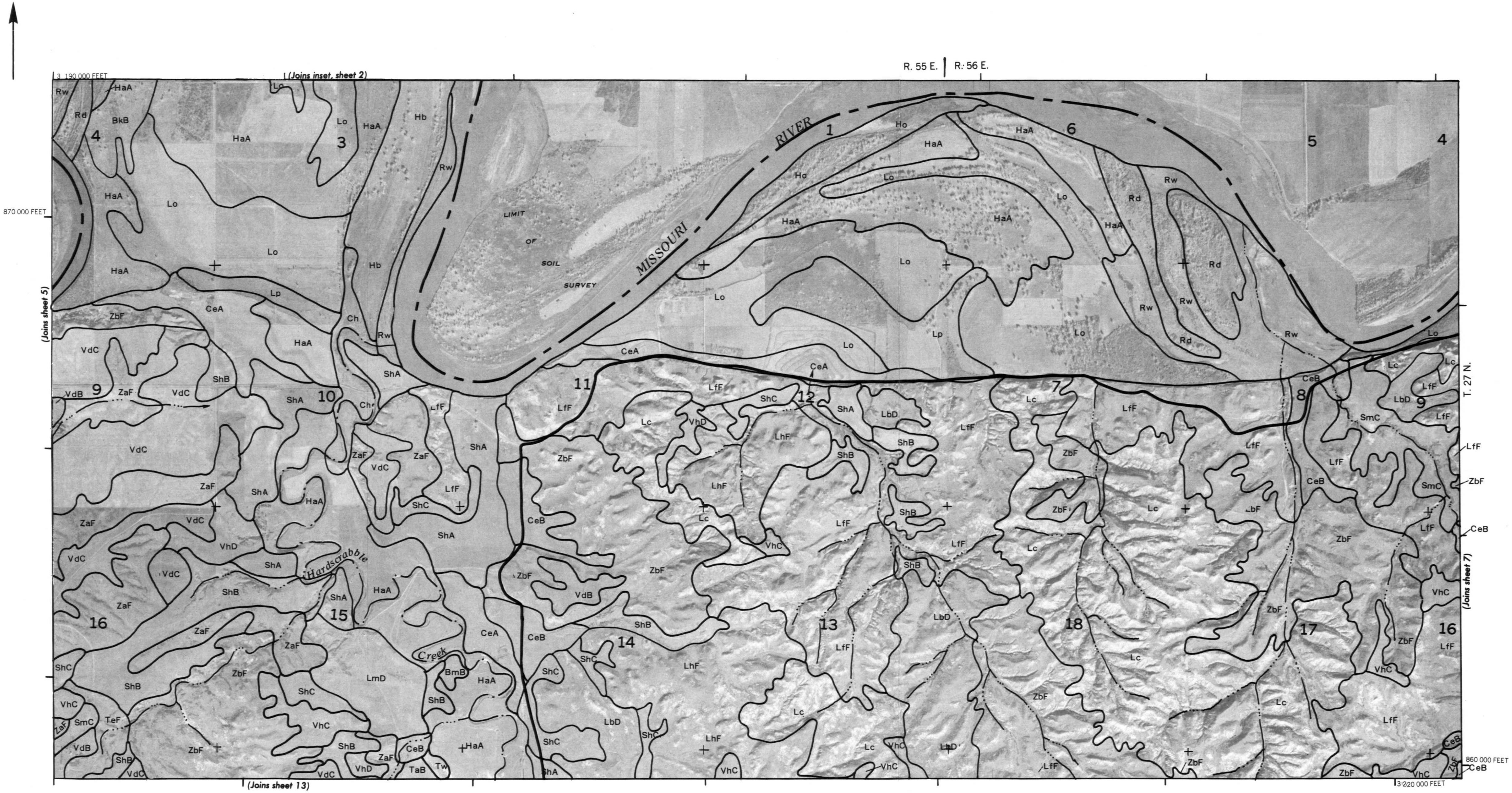
RICHLAND COUNTY, MONTANA — SHEET NUMBER 6



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

7

N

RICHLAND COUNTY, MONTANA NO. 7

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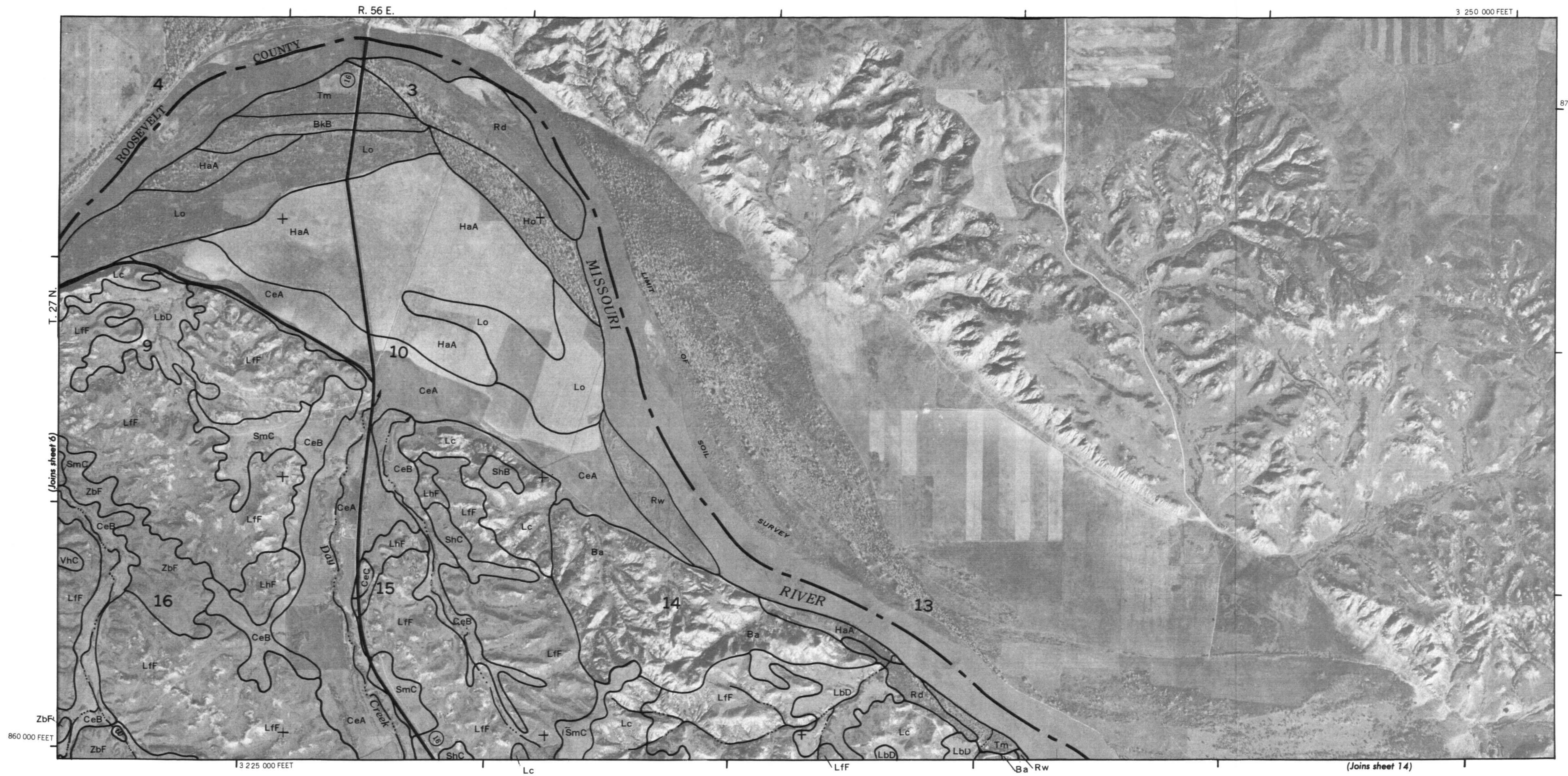

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Scale 1:24000

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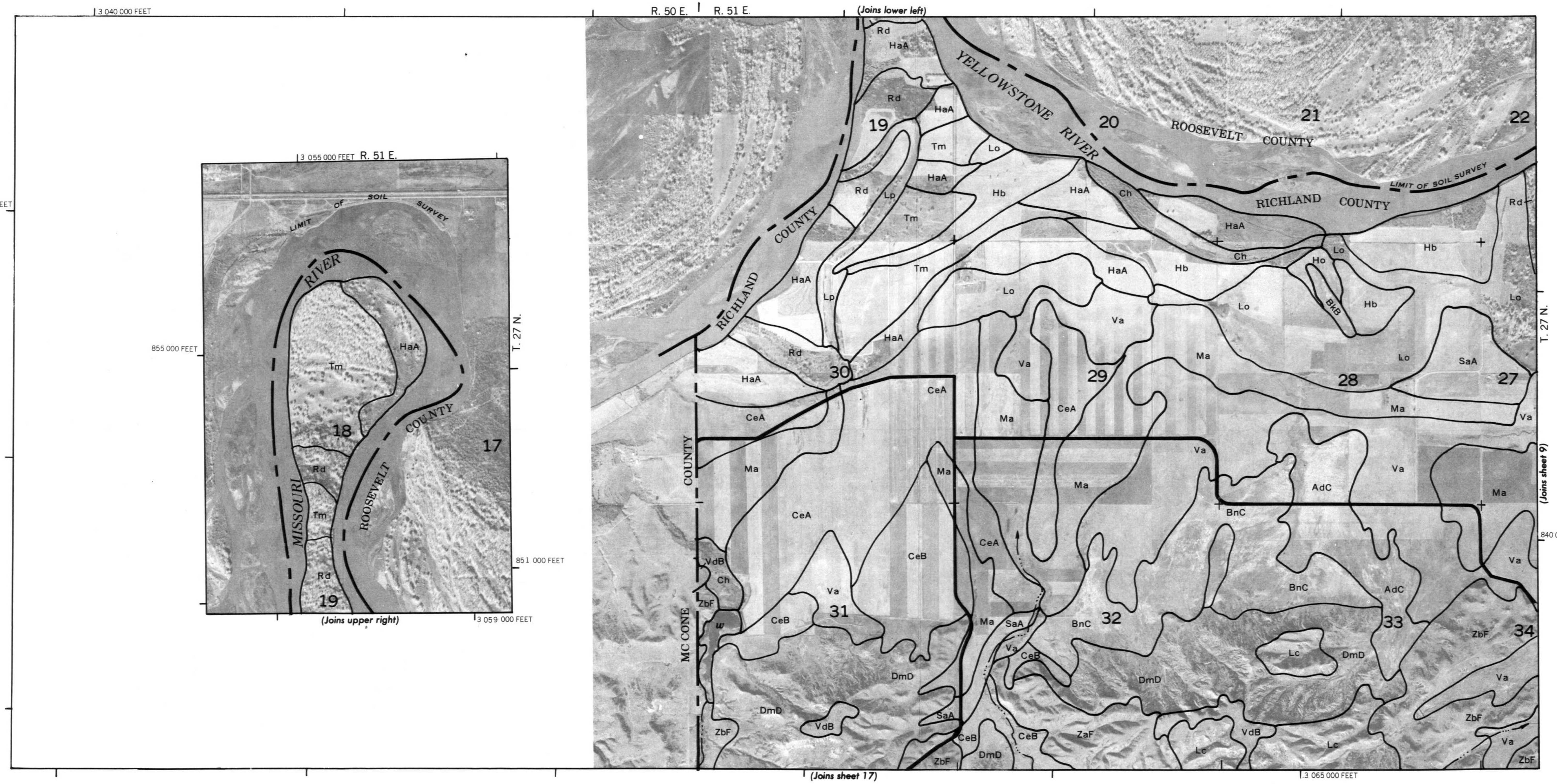
RICHLAND COUNTY, MONTANA — SHEET NUMBER 8



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

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RICHLAND COUNTY, MONTANA NO. 8

9

N

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

RICHLAND COUNTY, MONTANA NO. 9

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10

N

RICHLAND COUNTY, MONTANA — SHEET NUMBER 10

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

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RICHLAND COUNTY, MONTANA NO. 10

100

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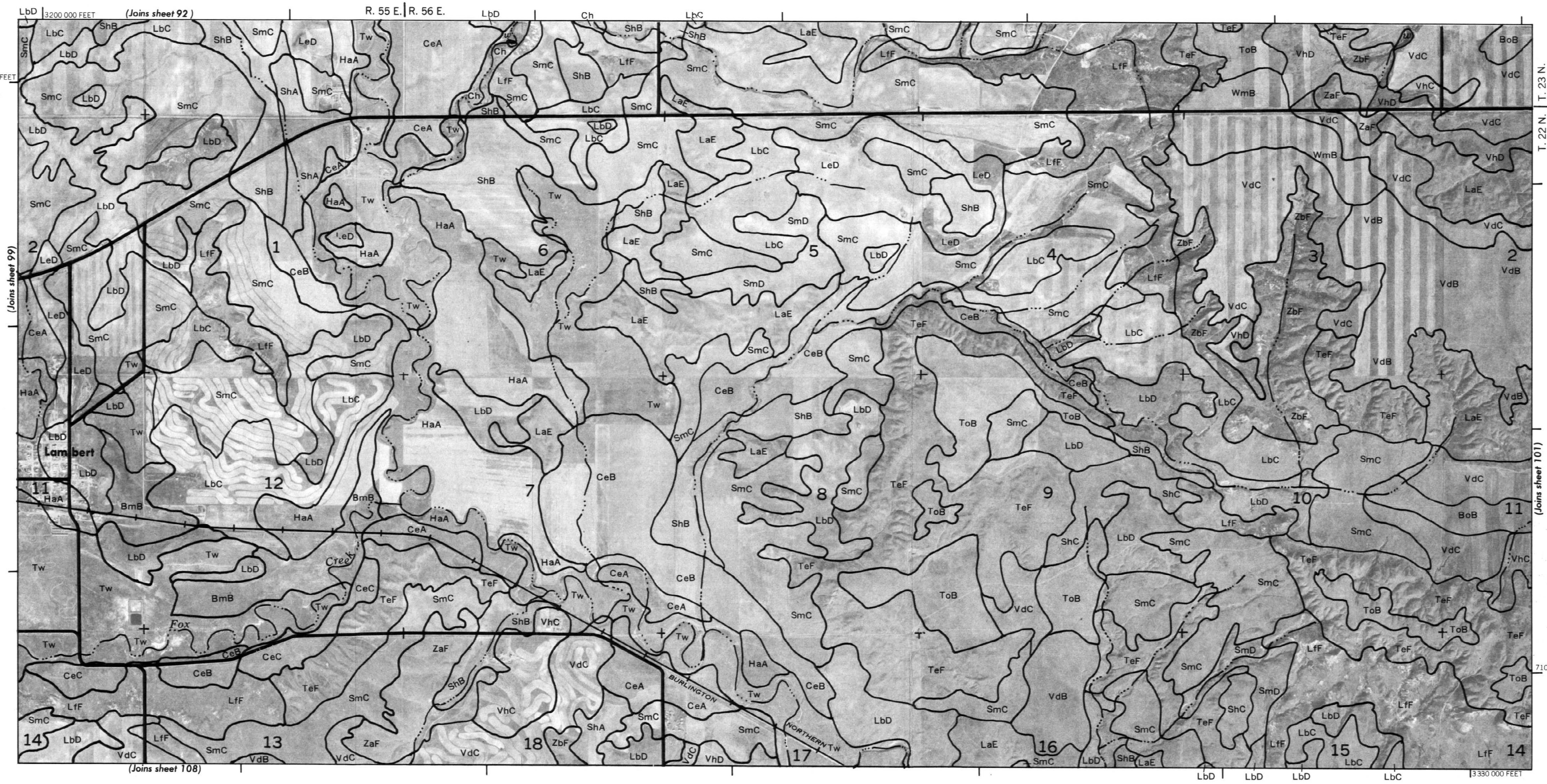
RICHLAND COUNTY, MONTANA — SHEET NUMBER 100



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

Scale 1:24 000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.
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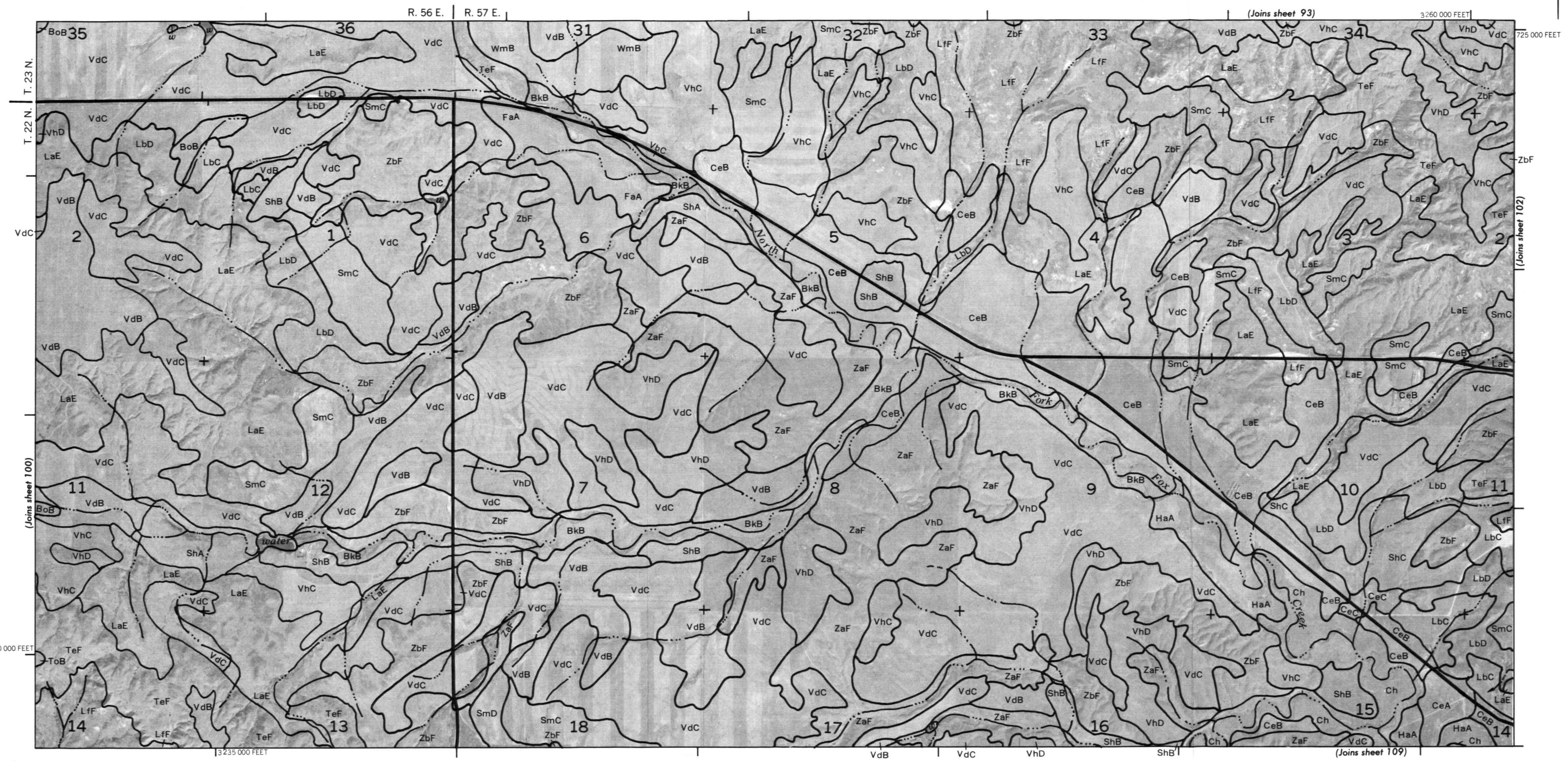
RICHLAND COUNTY, MONTANA NO. 100

101

N



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Scale 1:24000

RICHLAND COUNTY, MONTANA NO. 101

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RICHLAND COUNTY, MONTANA — SHEET NUMBER 102

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

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RICHLAND COUNTY, MONTANA NO. 103

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1 ¾ ½ ¼ 0 1 2 Miles

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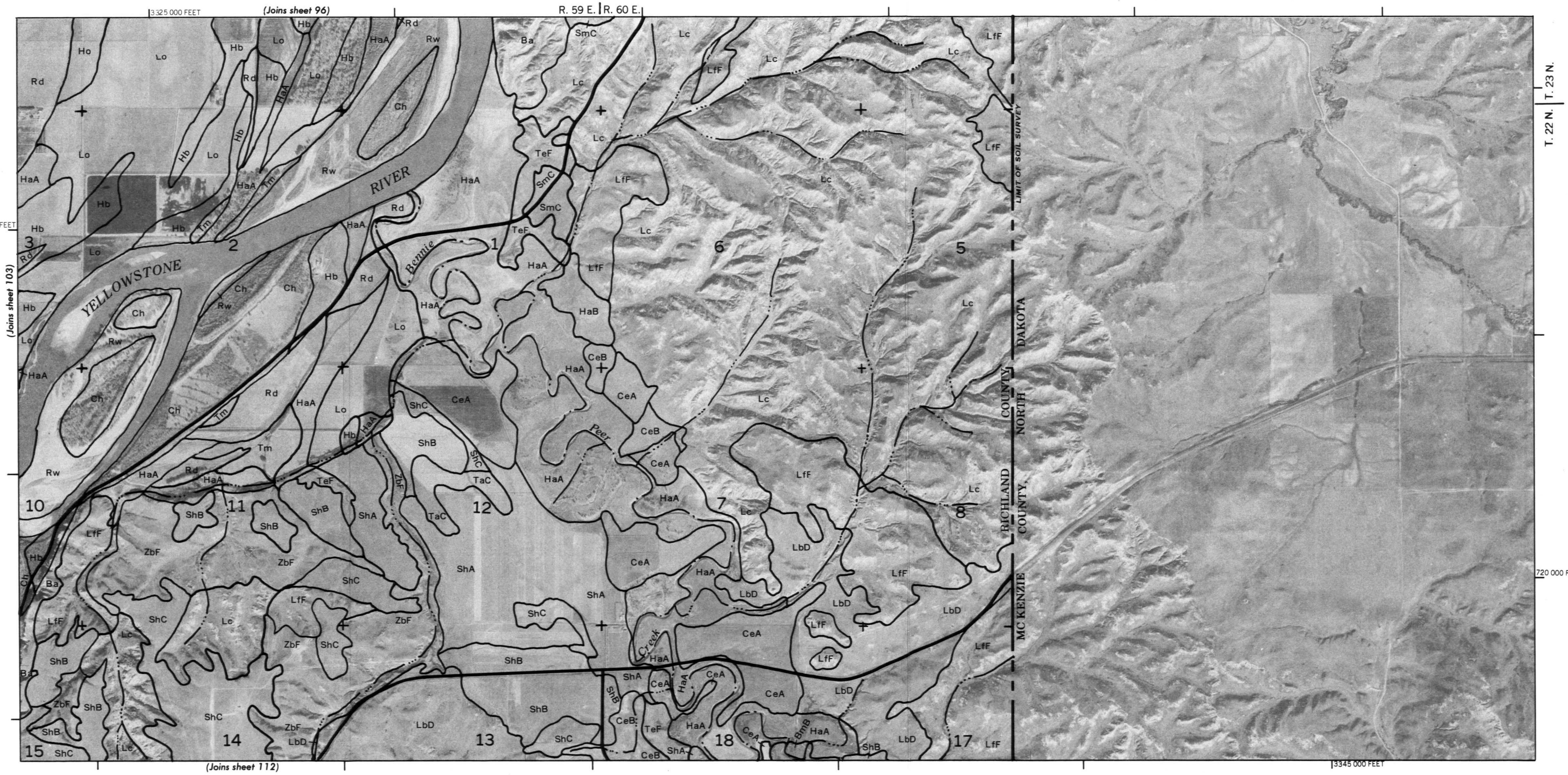
Scale 1:24000

RICHLAND COUNTY, MONTANA — SHEET NUMBER 104

N



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5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

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RICHLAND COUNTY, MONTANA NO. 104

105

N

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5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

1 ¾ ½ ¼ 0 1 2 Miles

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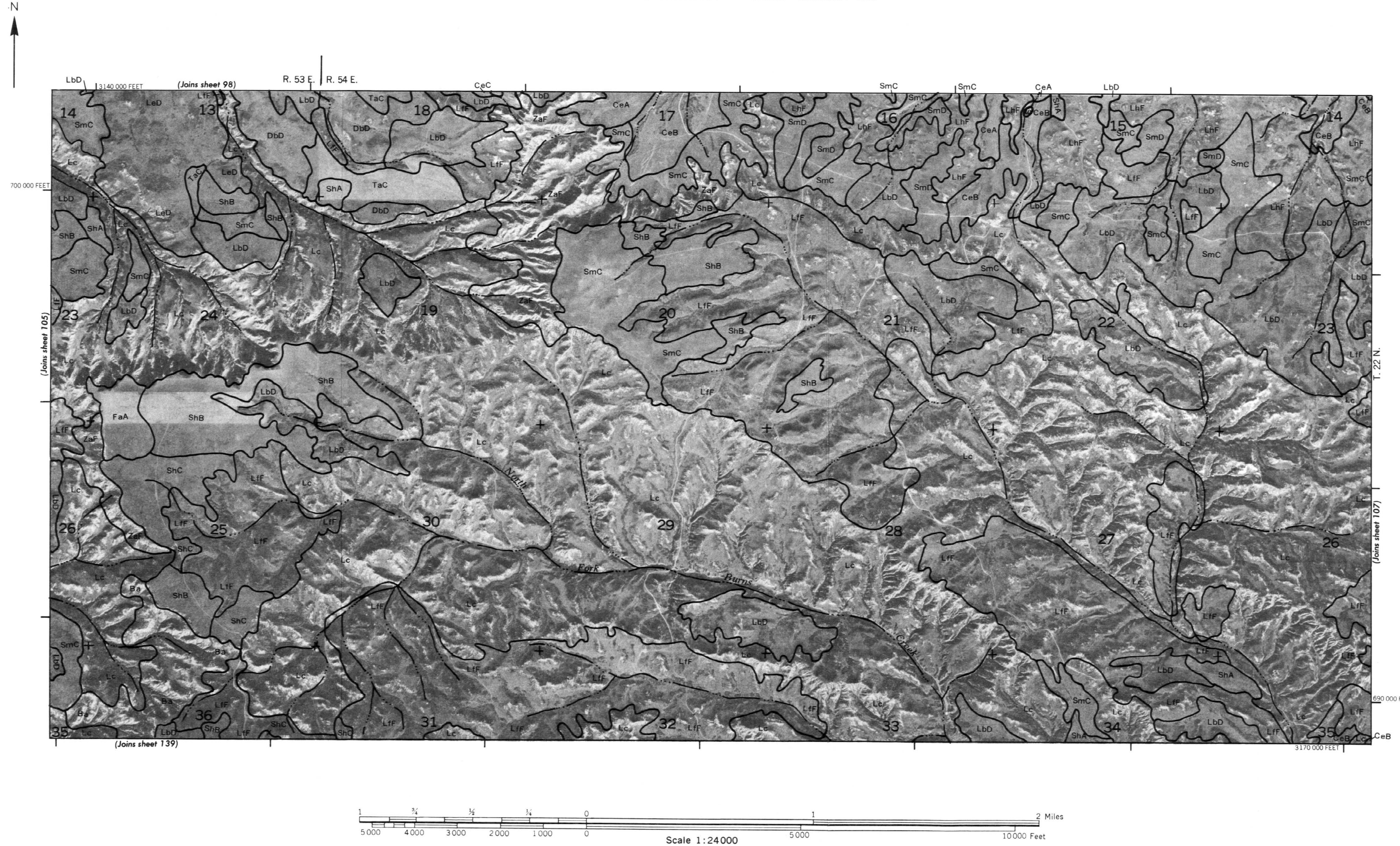
Scale 1:24000

RICHLAND COUNTY, MONTANA — SHEET NUMBER 106



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This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 106

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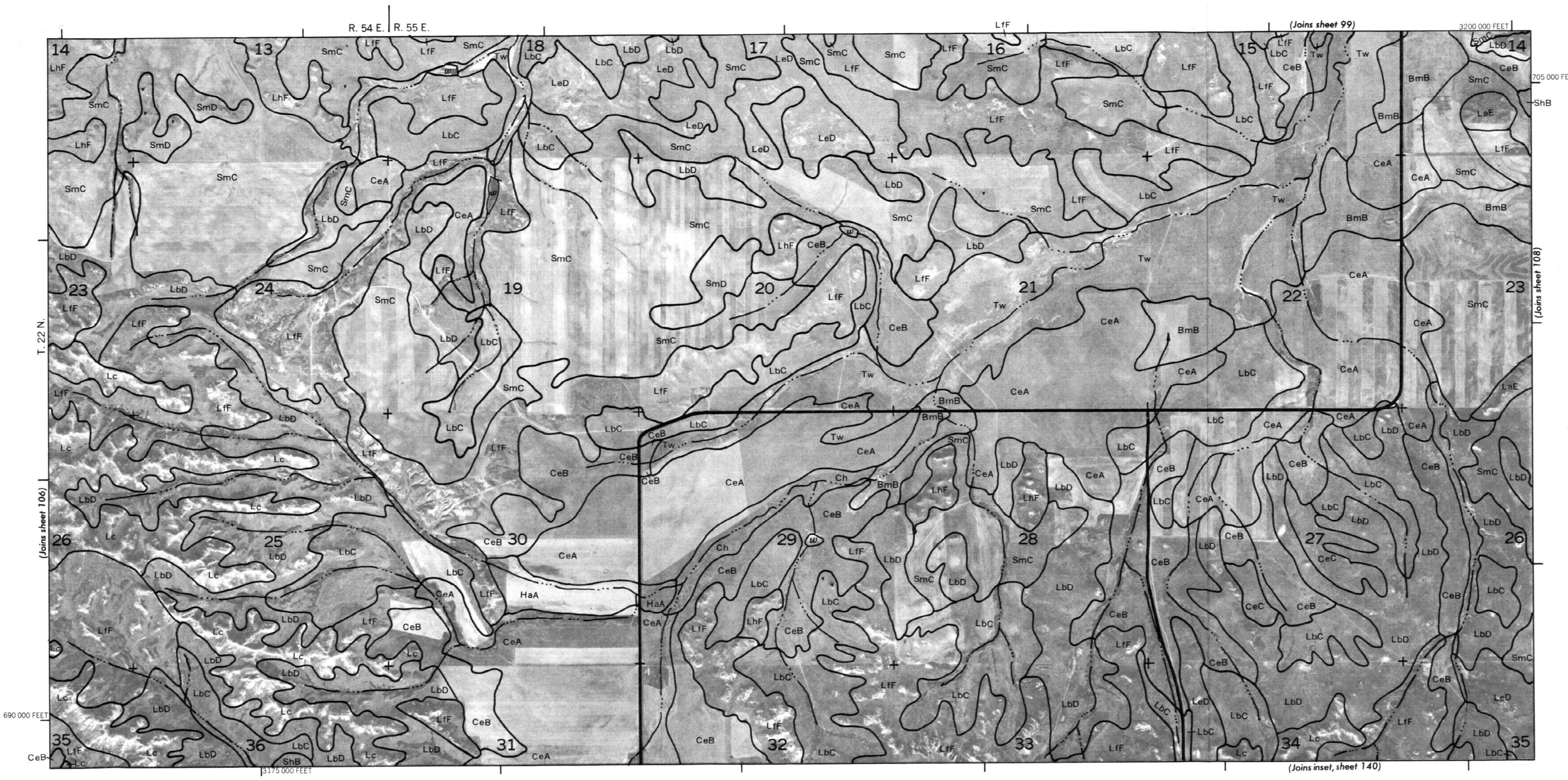

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

RICHLAND COUNTY, MONTANA NO. 107

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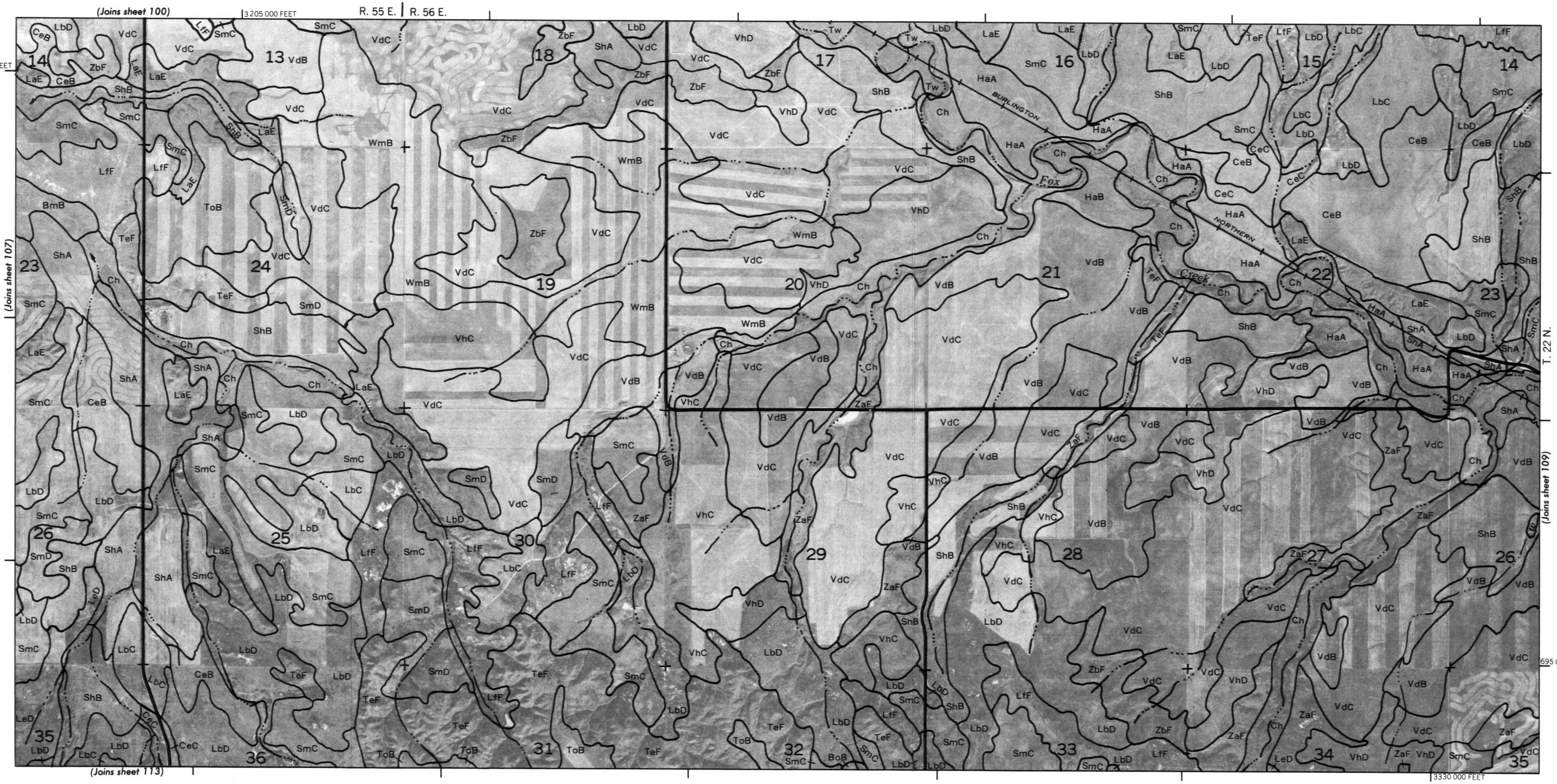
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

RICHLAND COUNTY, MONTANA — SHEET NUMBER 108

N



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

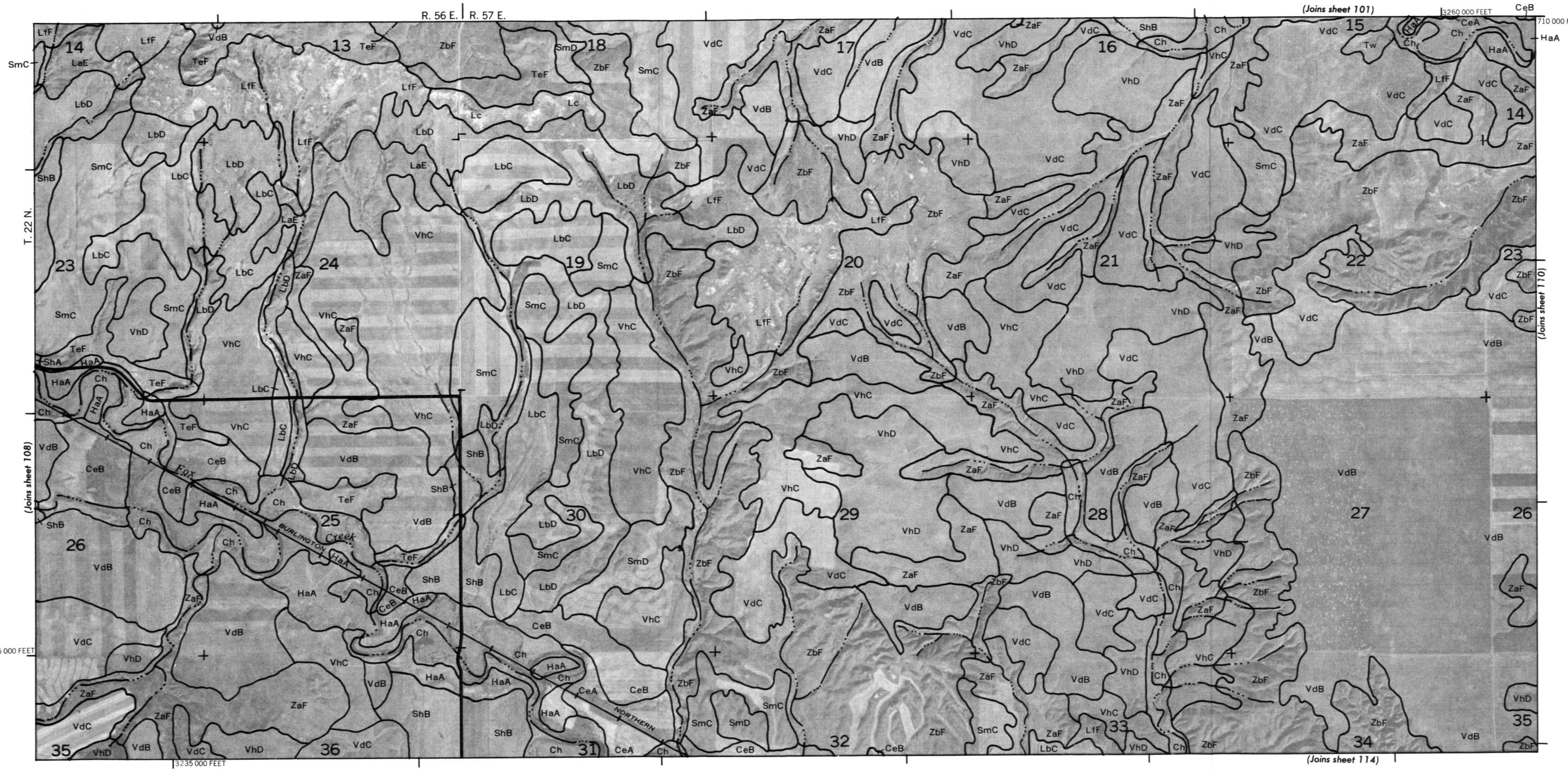
Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.
This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 108

109

N



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

RICHLAND COUNTY, MONTANA NO. 109

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

11

N

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

RICHLAND COUNTY, MONTANA NO. 11

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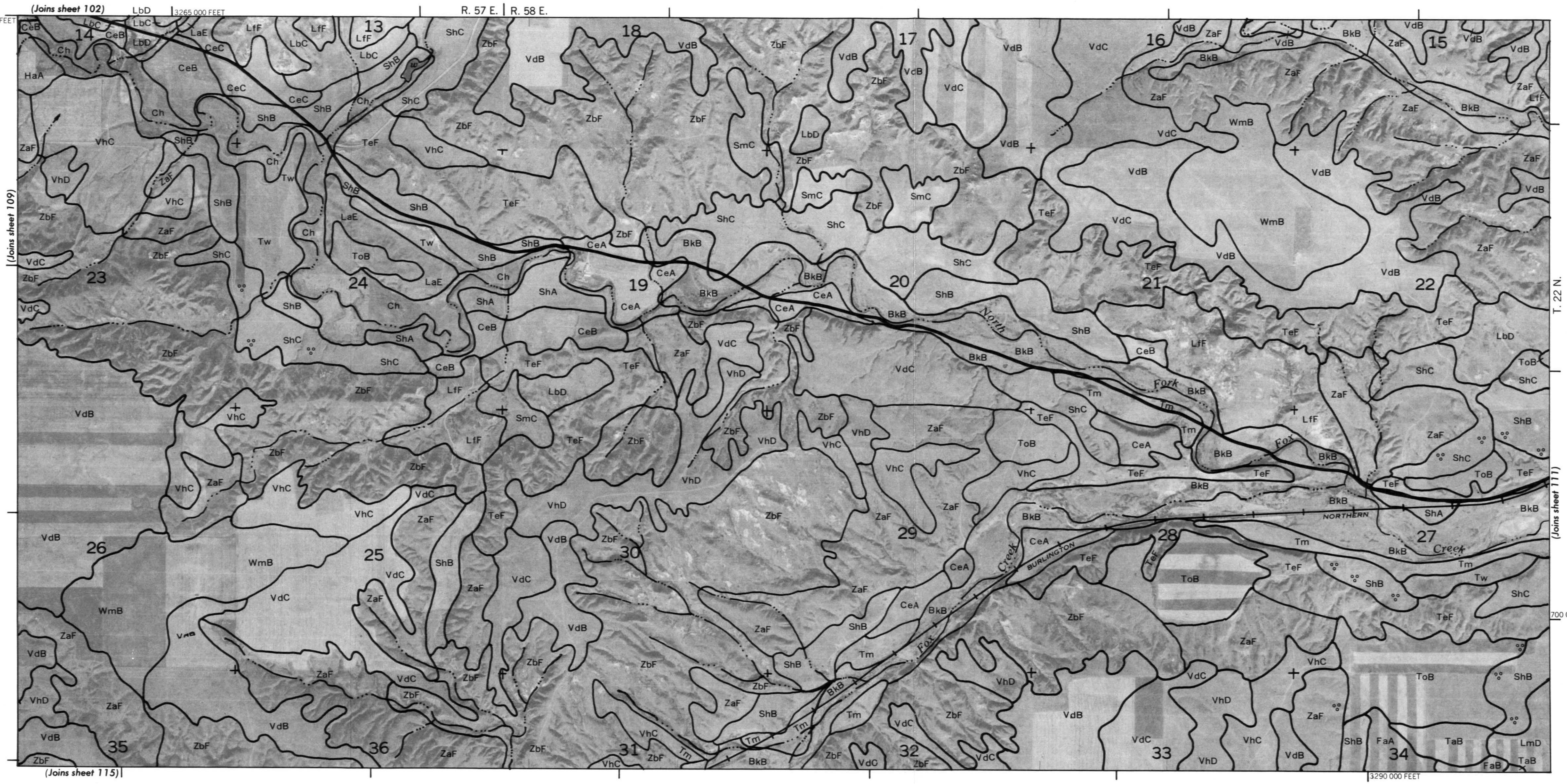
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

RICHLAND COUNTY, MONTANA — SHEET NUMBER 110

N



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

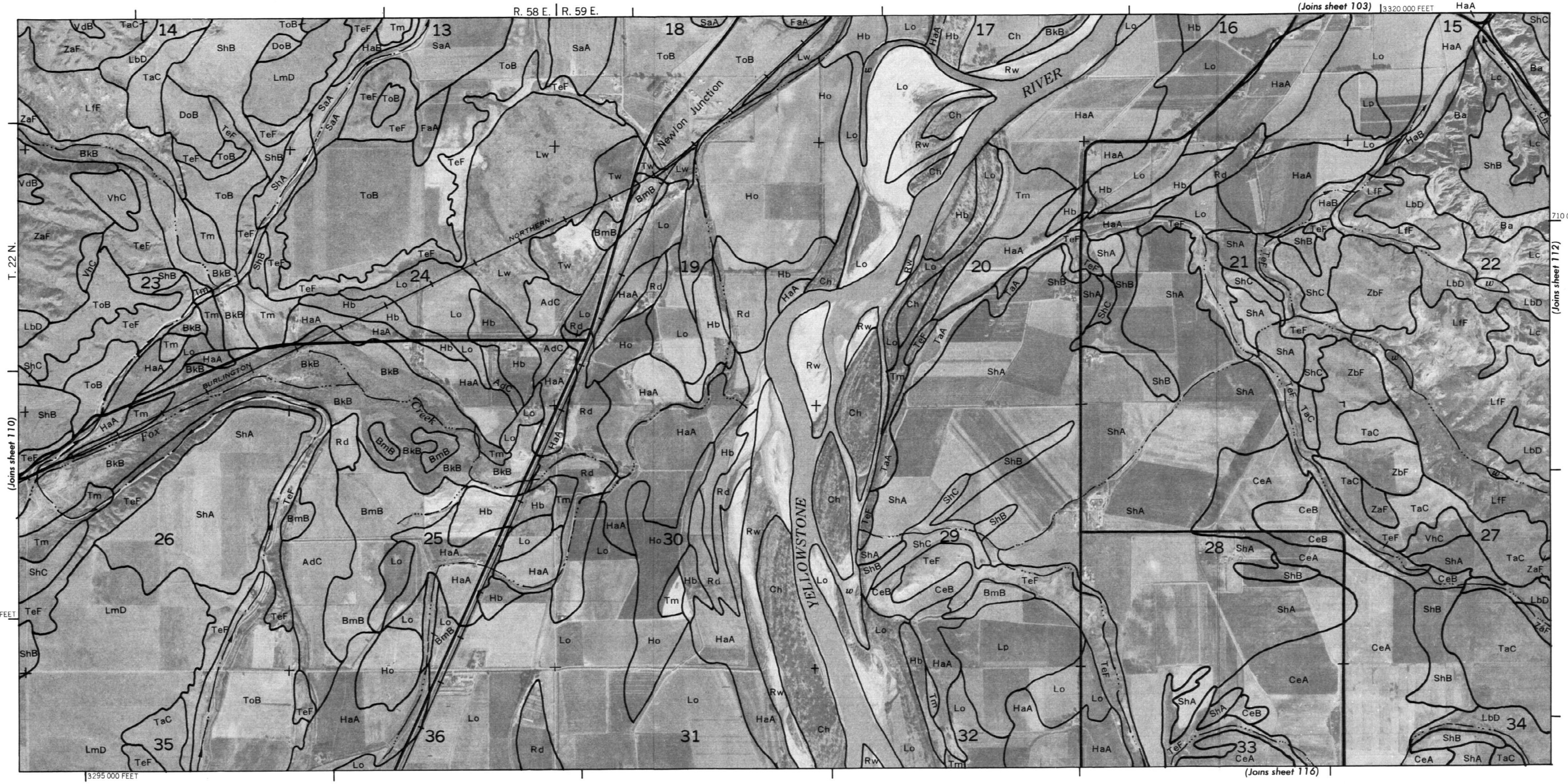
This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

111

N

RICHLAND COUNTY, MONTANA NO. 111

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



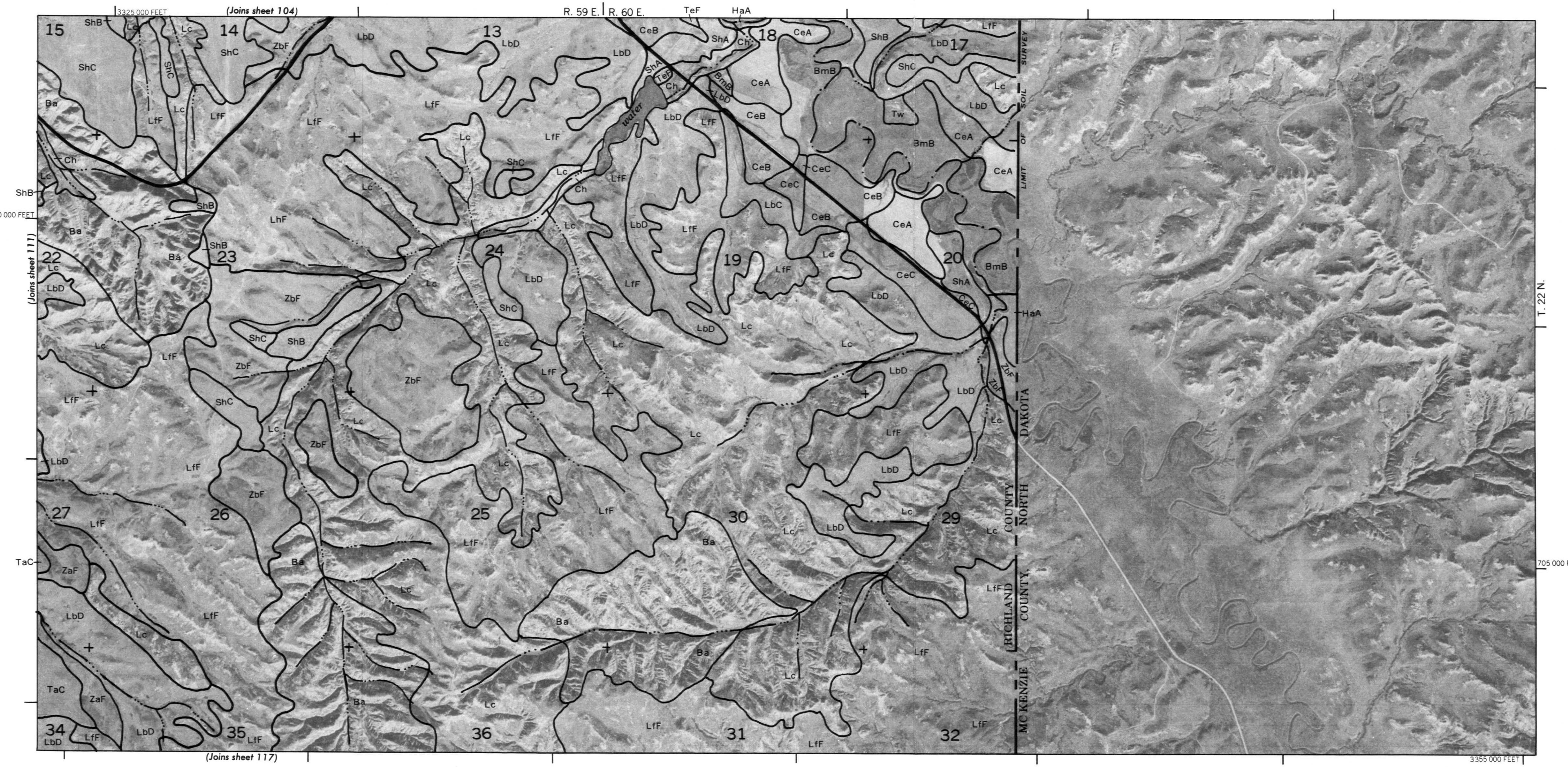
1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

N

RICHLAND COUNTY, MONTANA — SHEET NUMBER 112



1 ¾ ½ ¼ 0 1 2 Miles

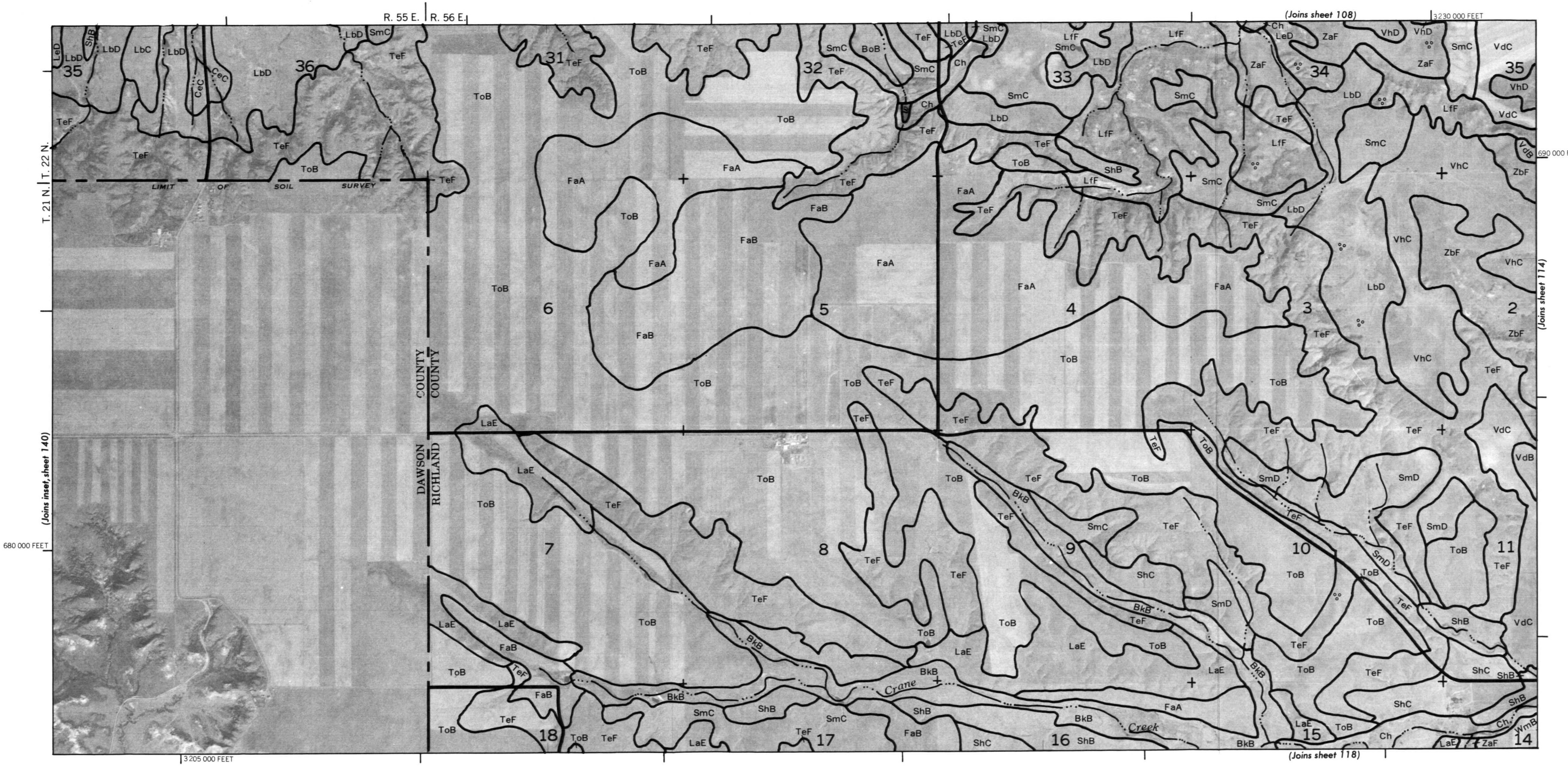
5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

N



1 ¾ ½ ¼ 0 1 2 Miles

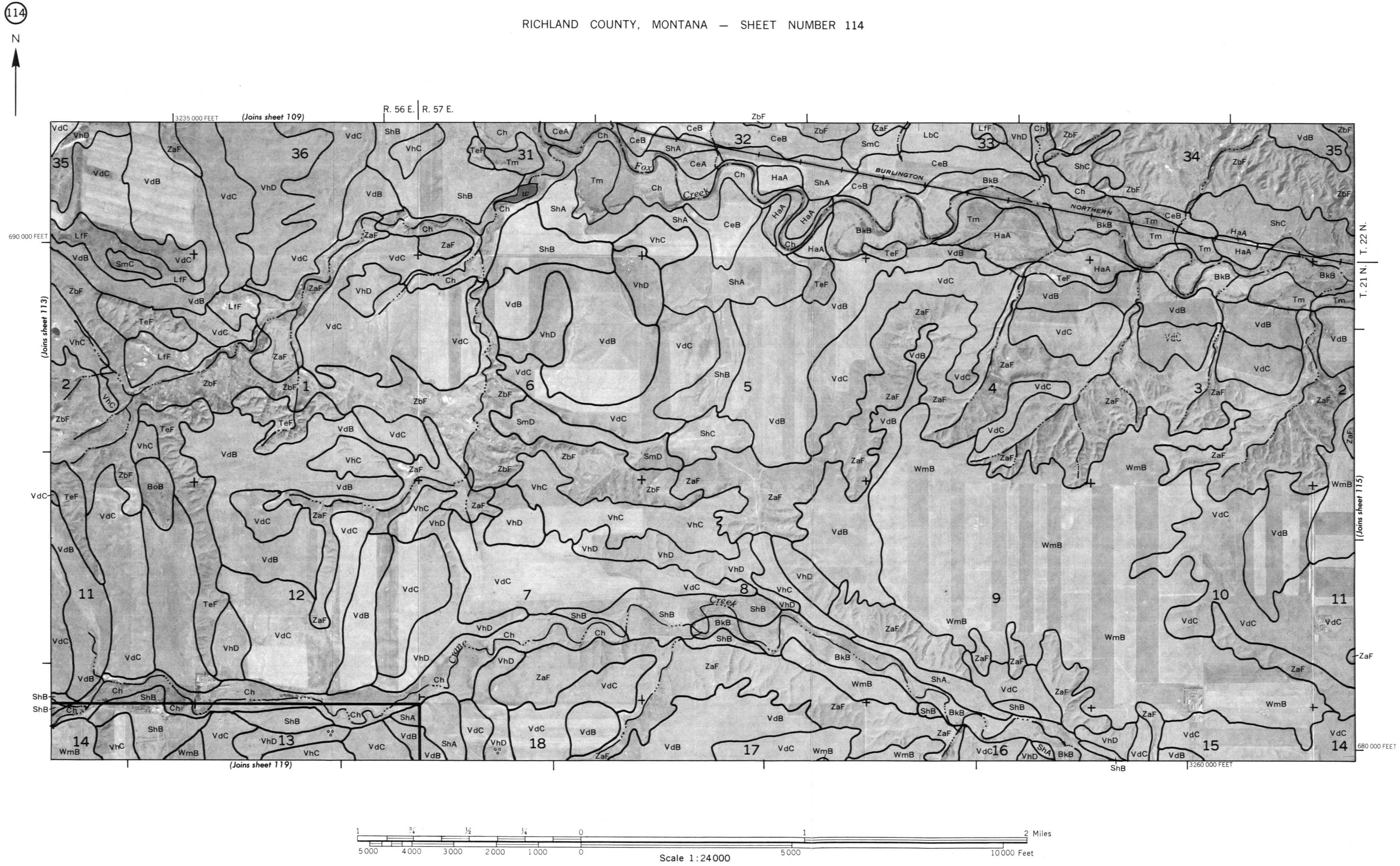
5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

Scale 1:24 000

RICHLAND COUNTY, MONTANA NO. 113

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

RICHLAND COUNTY, MONTANA — SHEET NUMBER 114

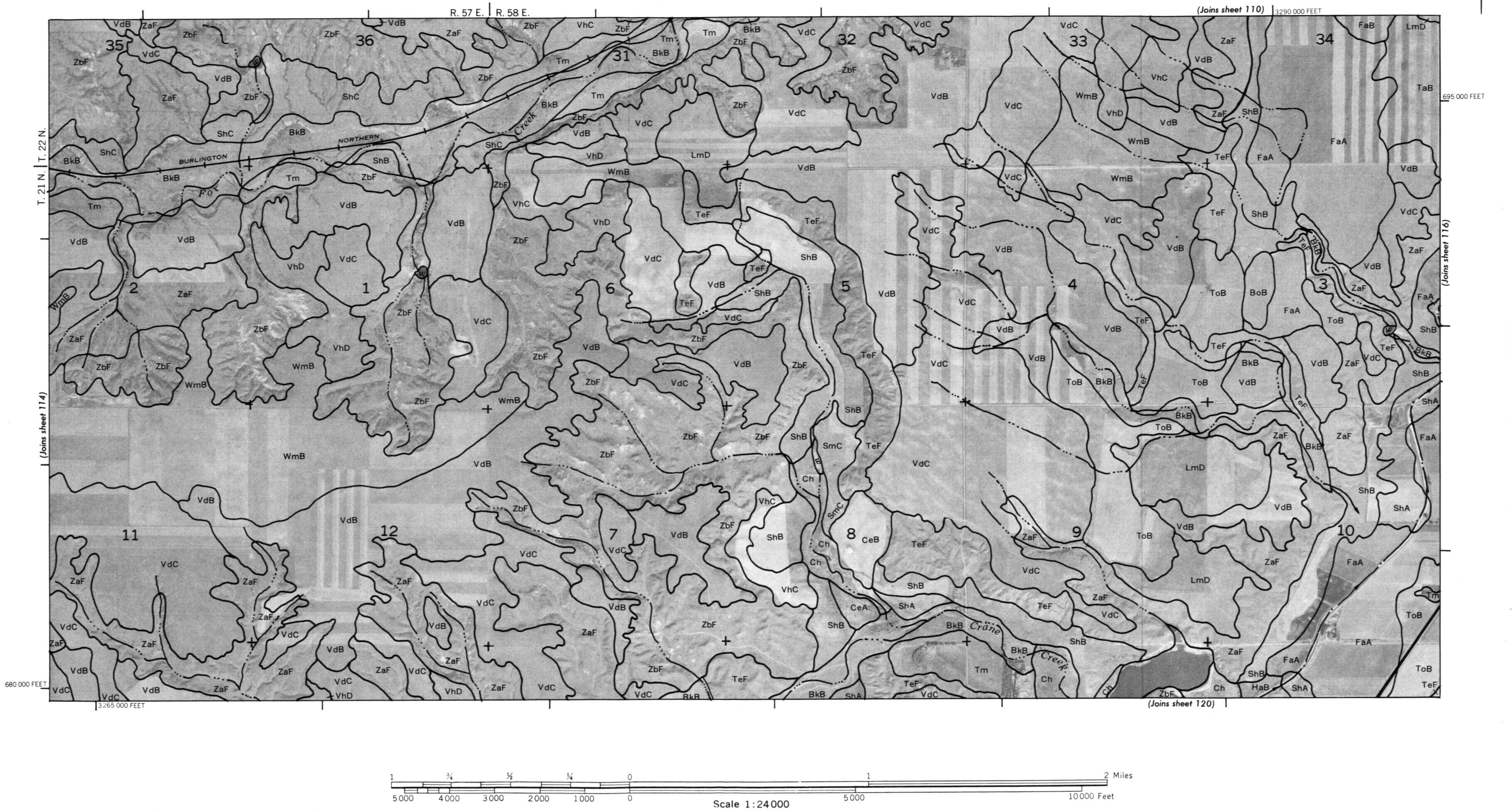


5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

115

N

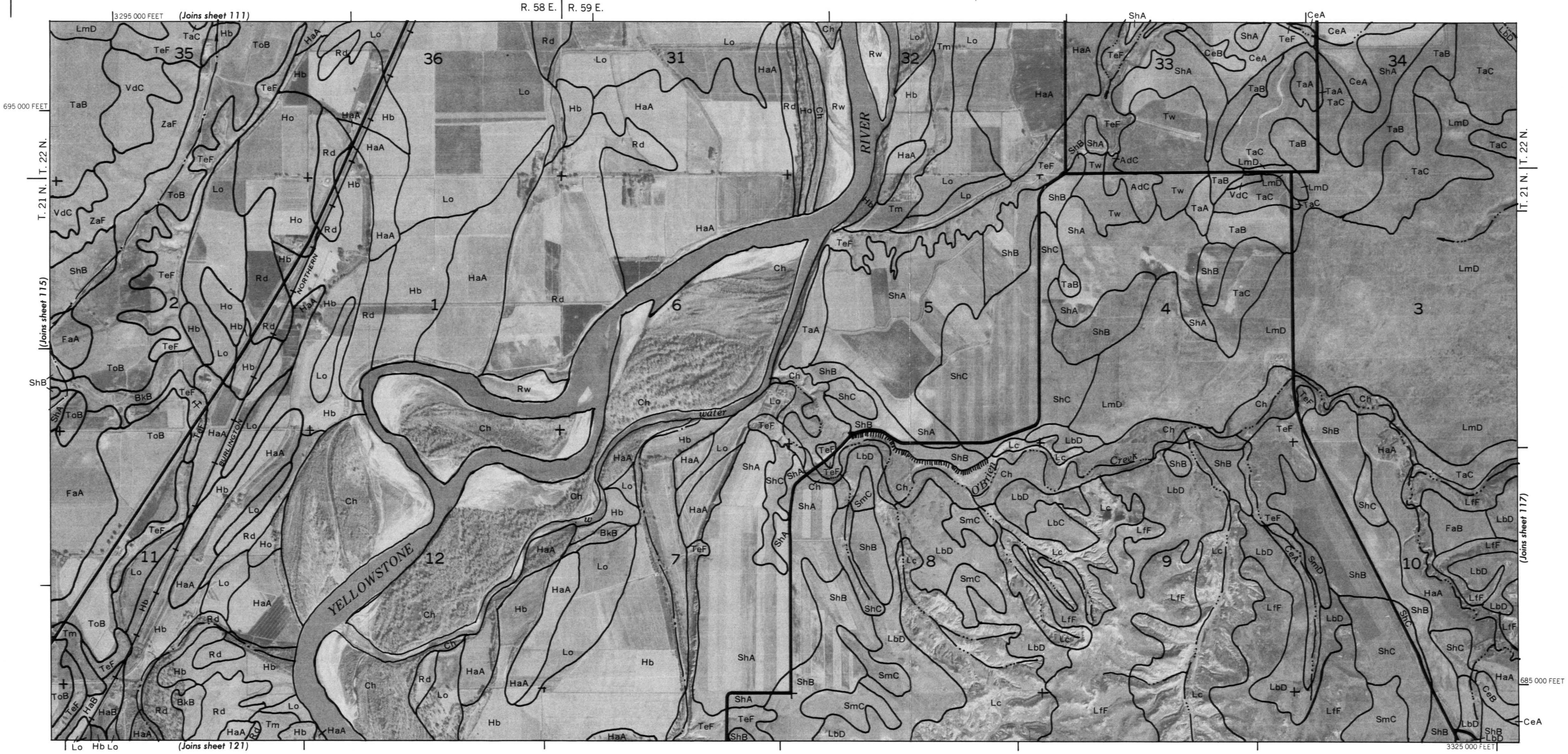


Scale 1:24 000

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

RICHLAND COUNTY, MONTANA — SHEET NUMBER 116

N



1 ¾ ½ ¼ 0 1 2 Miles

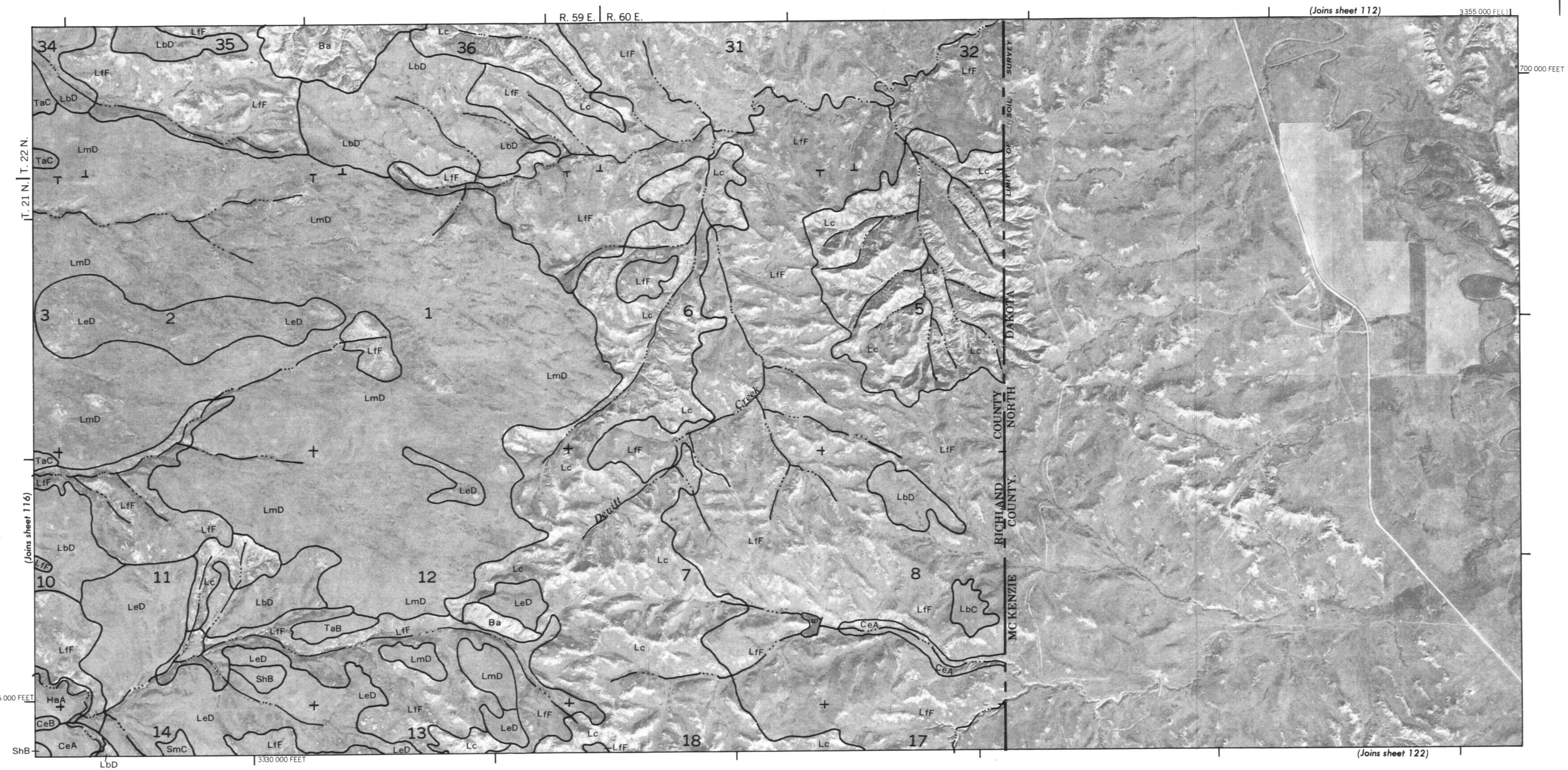
5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

RICHLAND COUNTY, MONTANA NO. 116



Scale 1:24 000

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

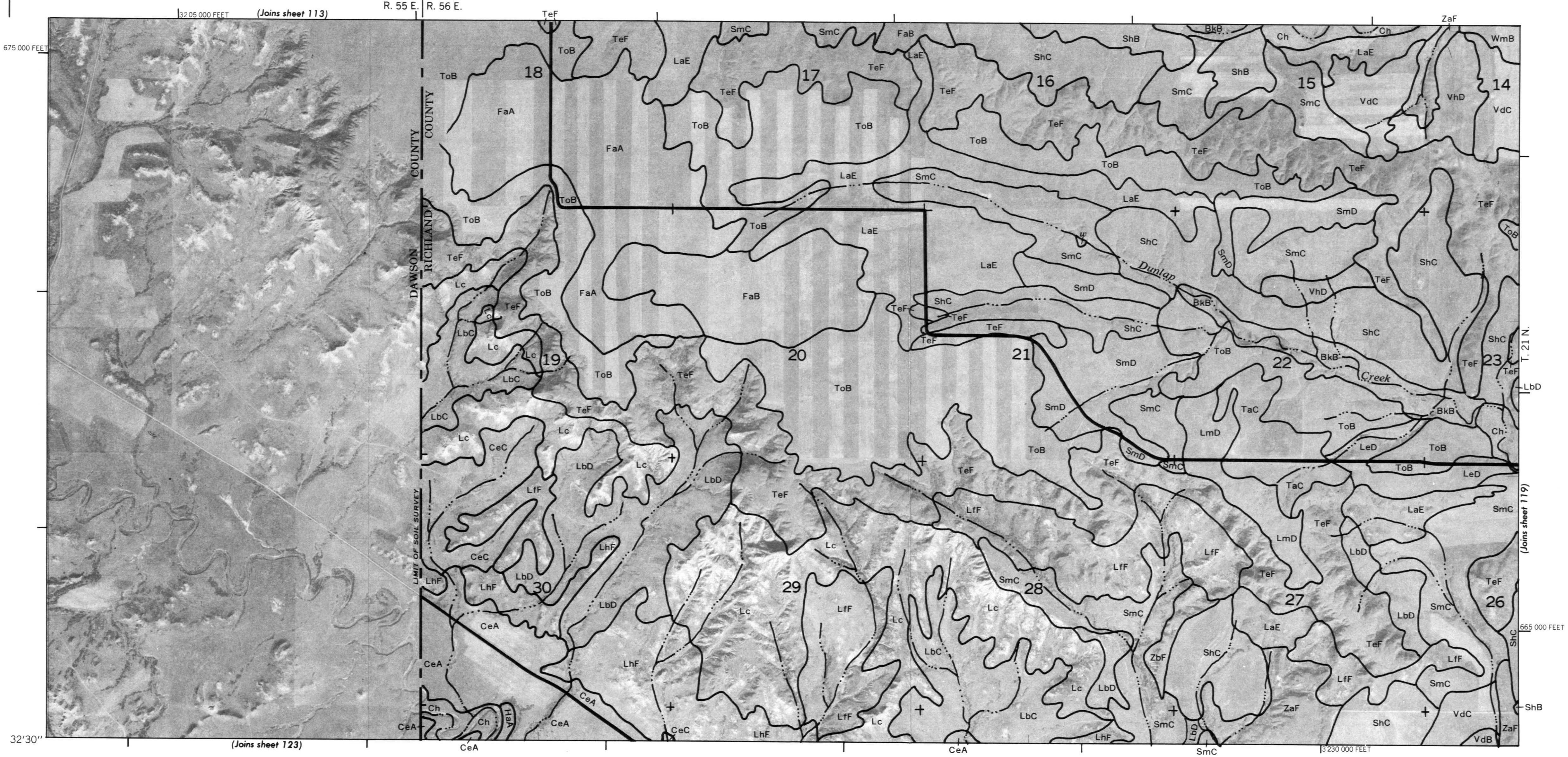
RICHLAND COUNTY, MONTANA NO. 117

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

118

N

RICHLAND COUNTY, MONTANA — SHEET NUMBER 118



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

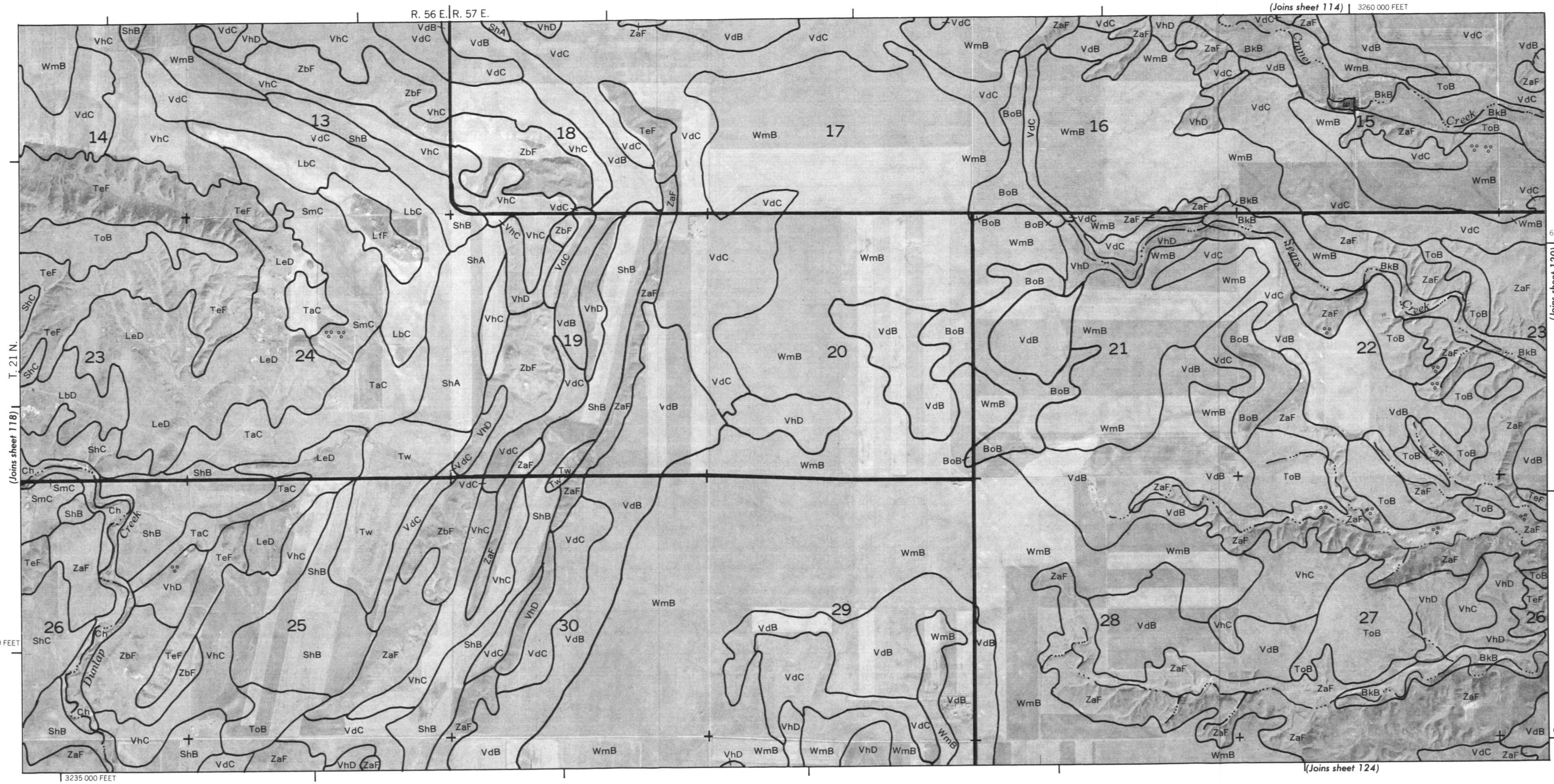
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

N

RICHLAND COUNTY, MONTANA NO. 119

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned



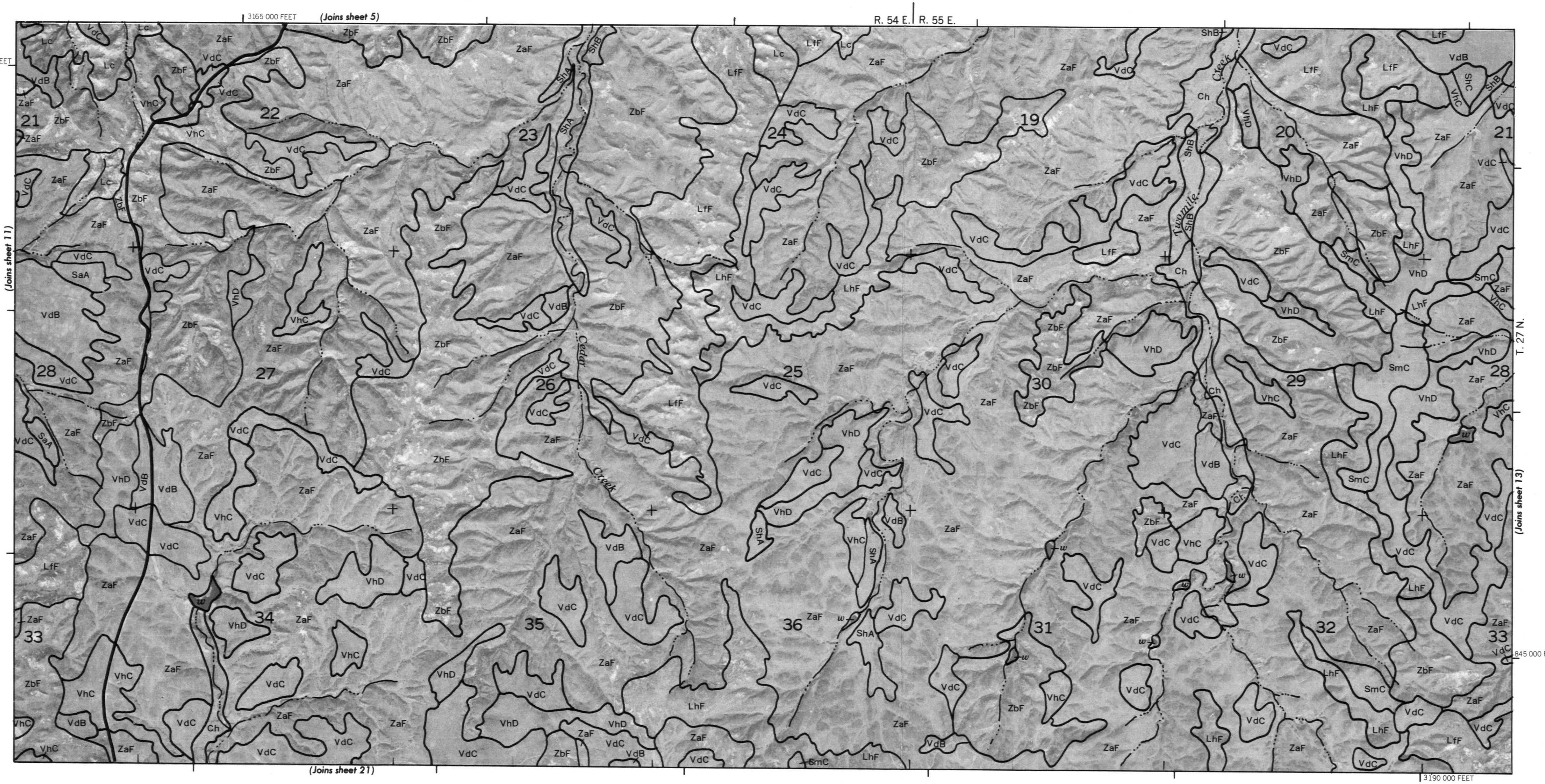
1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

N

RICHLAND COUNTY, MONTANA — SHEET NUMBER 12



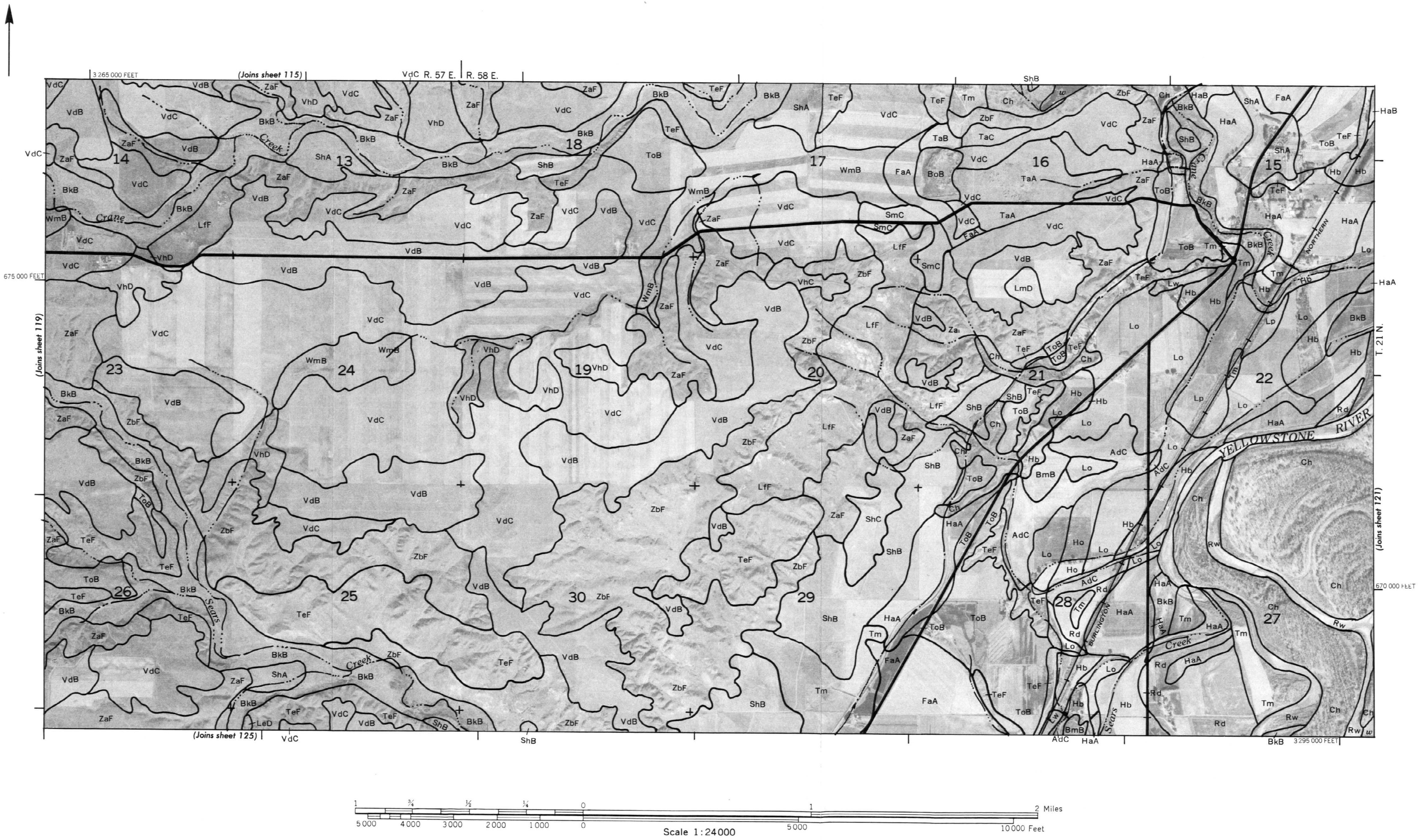
1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

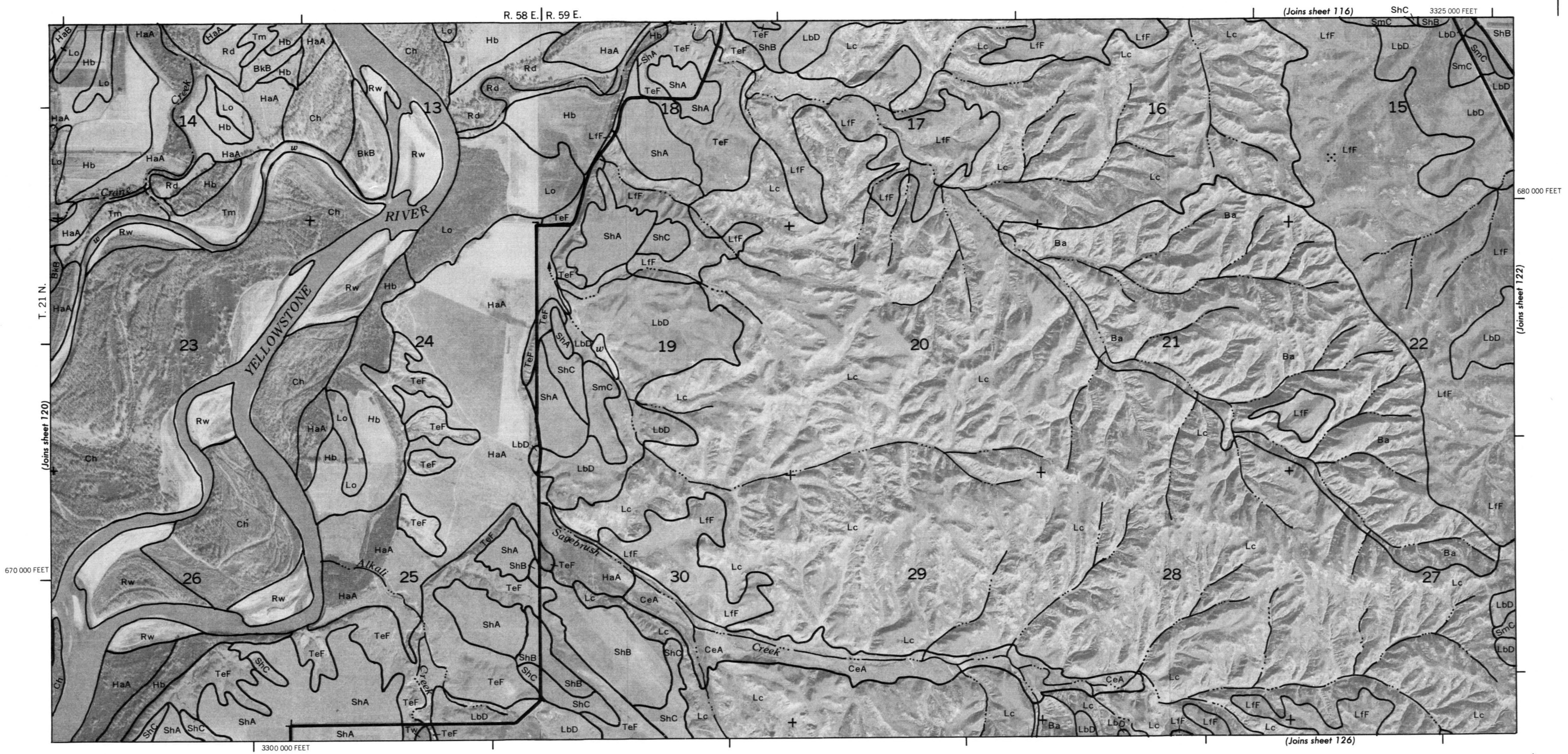
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.



5 000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.
This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 120



1 ¾ ½ ¼ 0 1 2 Miles

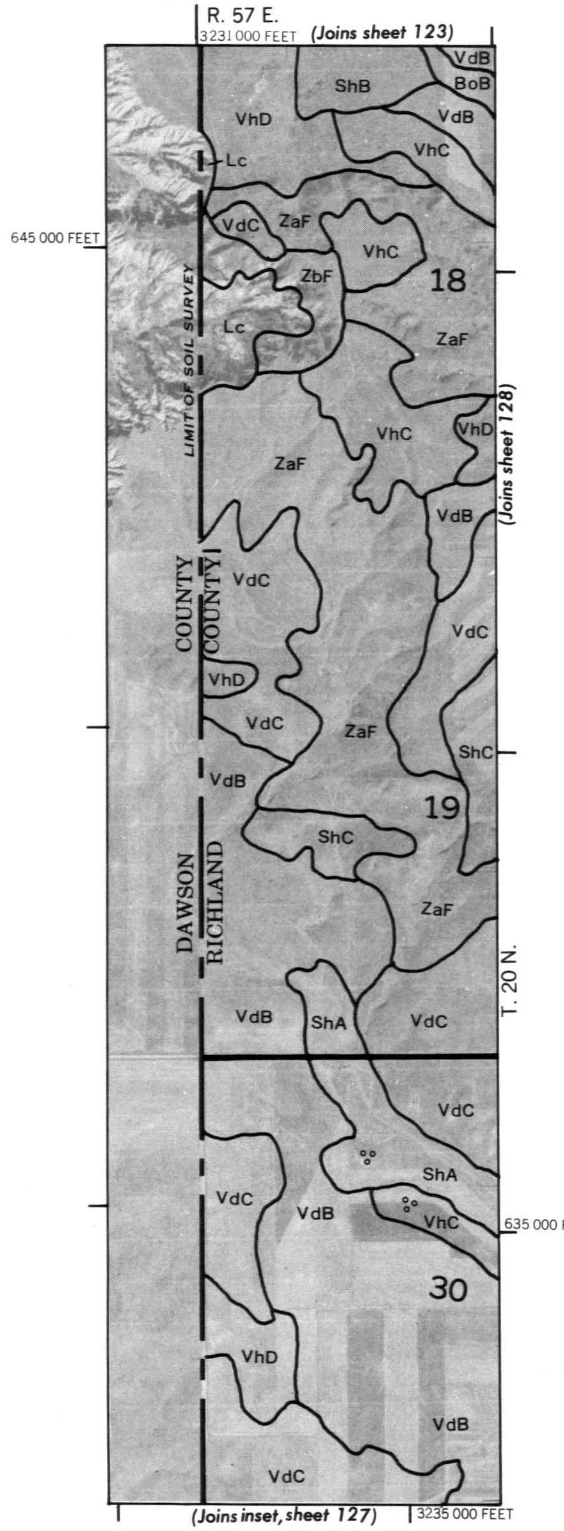
5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

RICHLAND COUNTY, MONTANA NO. 121

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

RICHLAND COUNTY, MONTANA — SHEET NUMBER 122



3000 AND 5000-FOOT GRID TICKS

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

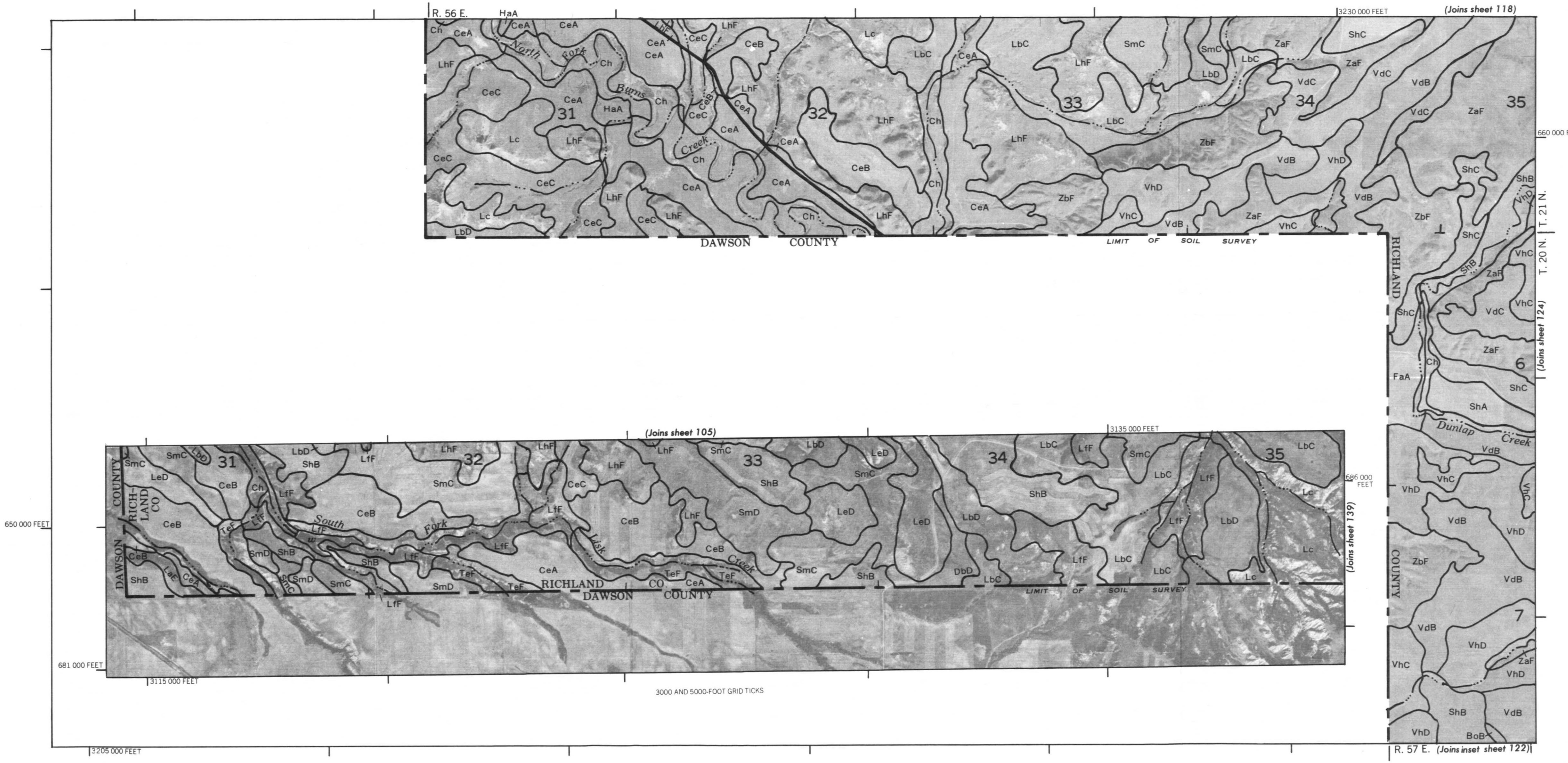
Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 123

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. 5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

N

RICHLAND COUNTY, MONTANA — SHEET NUMBER 124

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.
This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 124

125

N

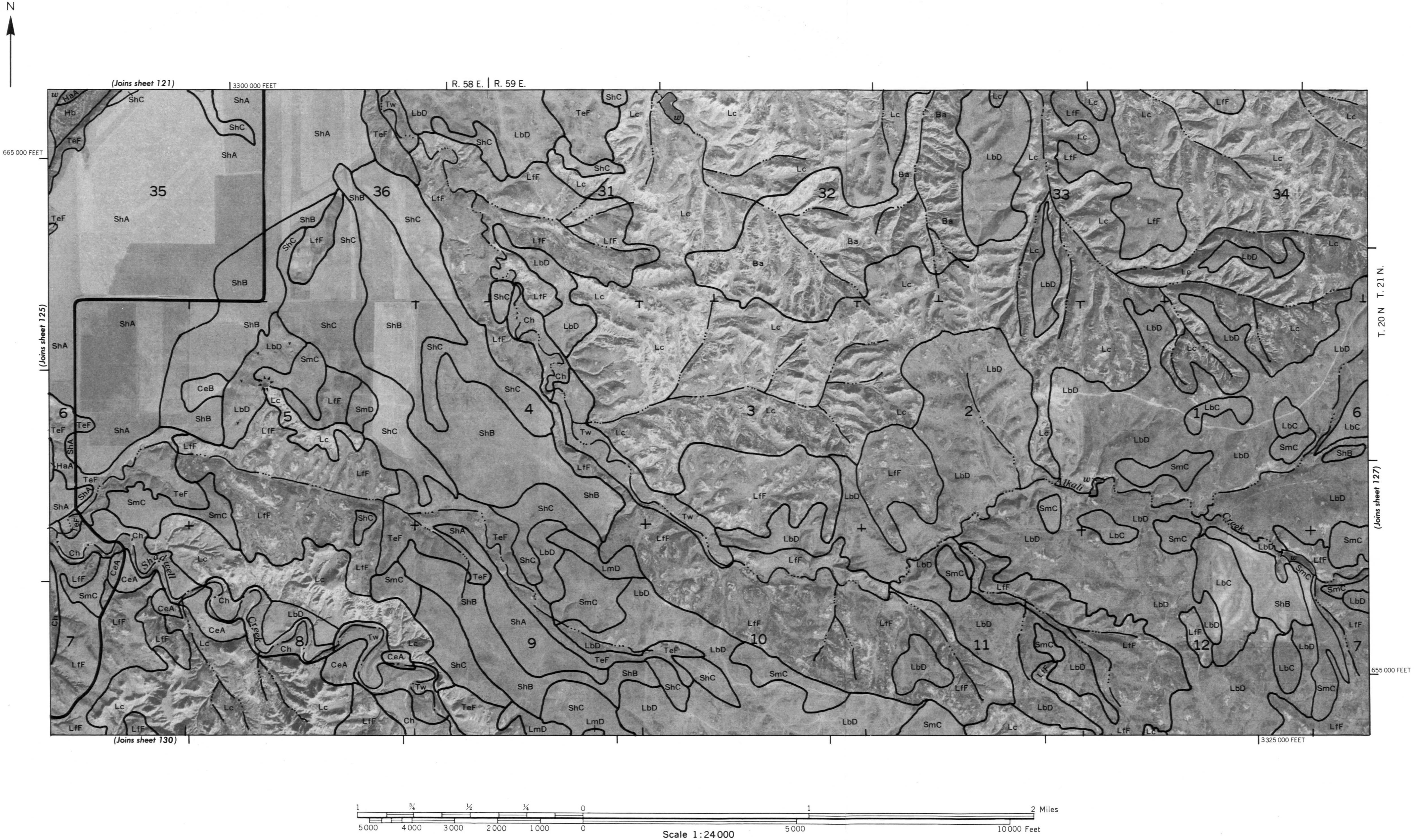
1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

RICHLAND COUNTY, MONTANA — SHEET NUMBER 126

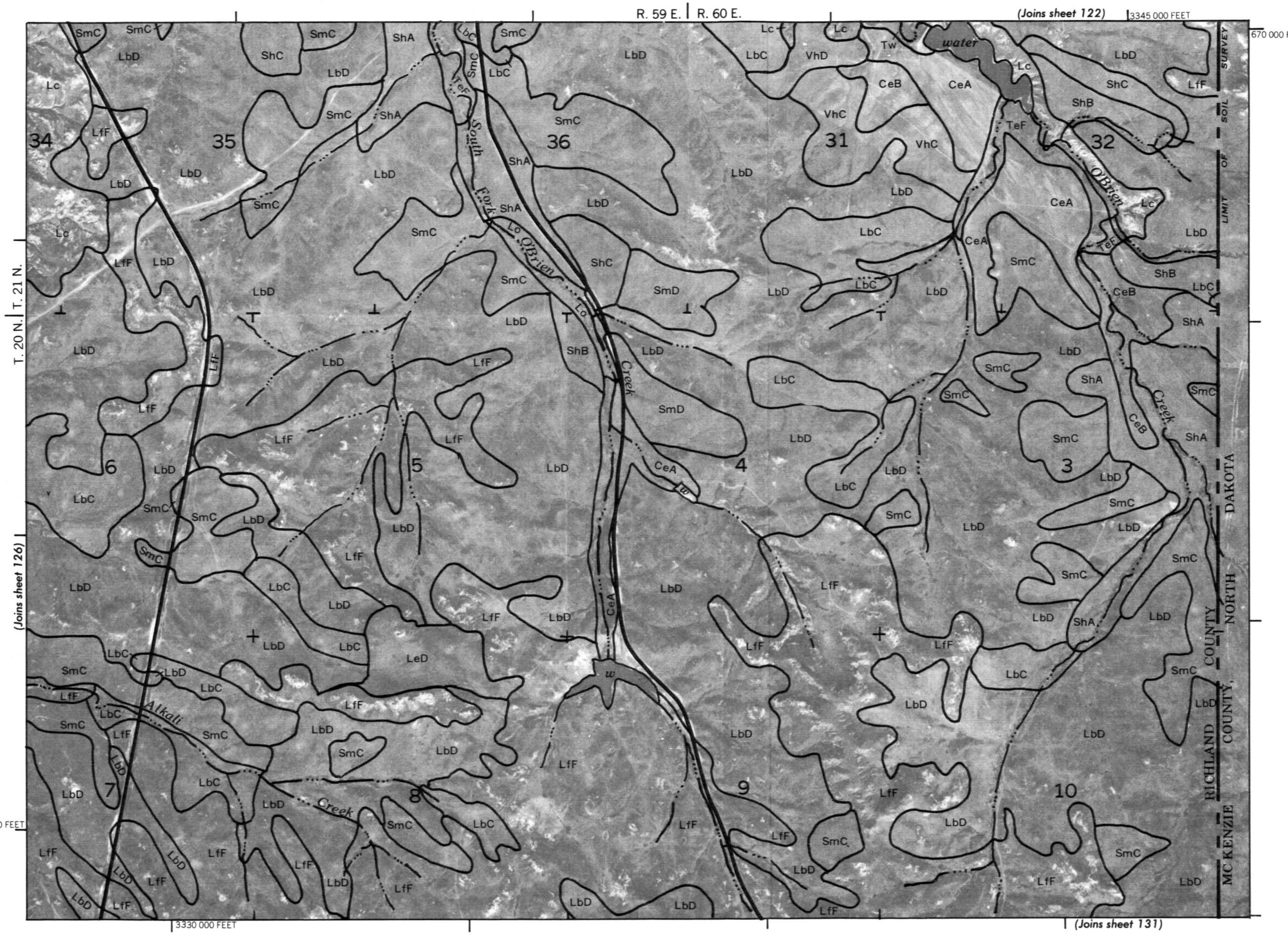


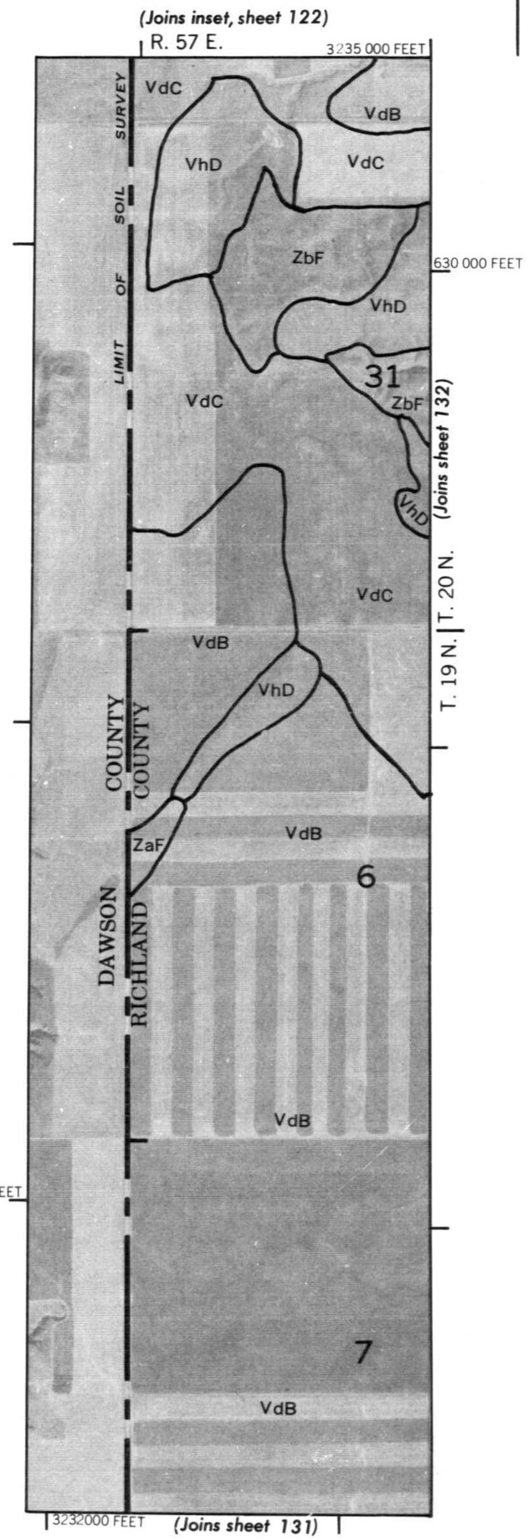
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

127

N





3000 AND 5000-FOOT GRID TICKS

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

RICHLAND COUNTY, MONTANA NO. 127

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

RICHLAND COUNTY, MONTANA — SHEET NUMBER 128

N

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

129

N

RICHLAND COUNTY, MONTANA NO. 129

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

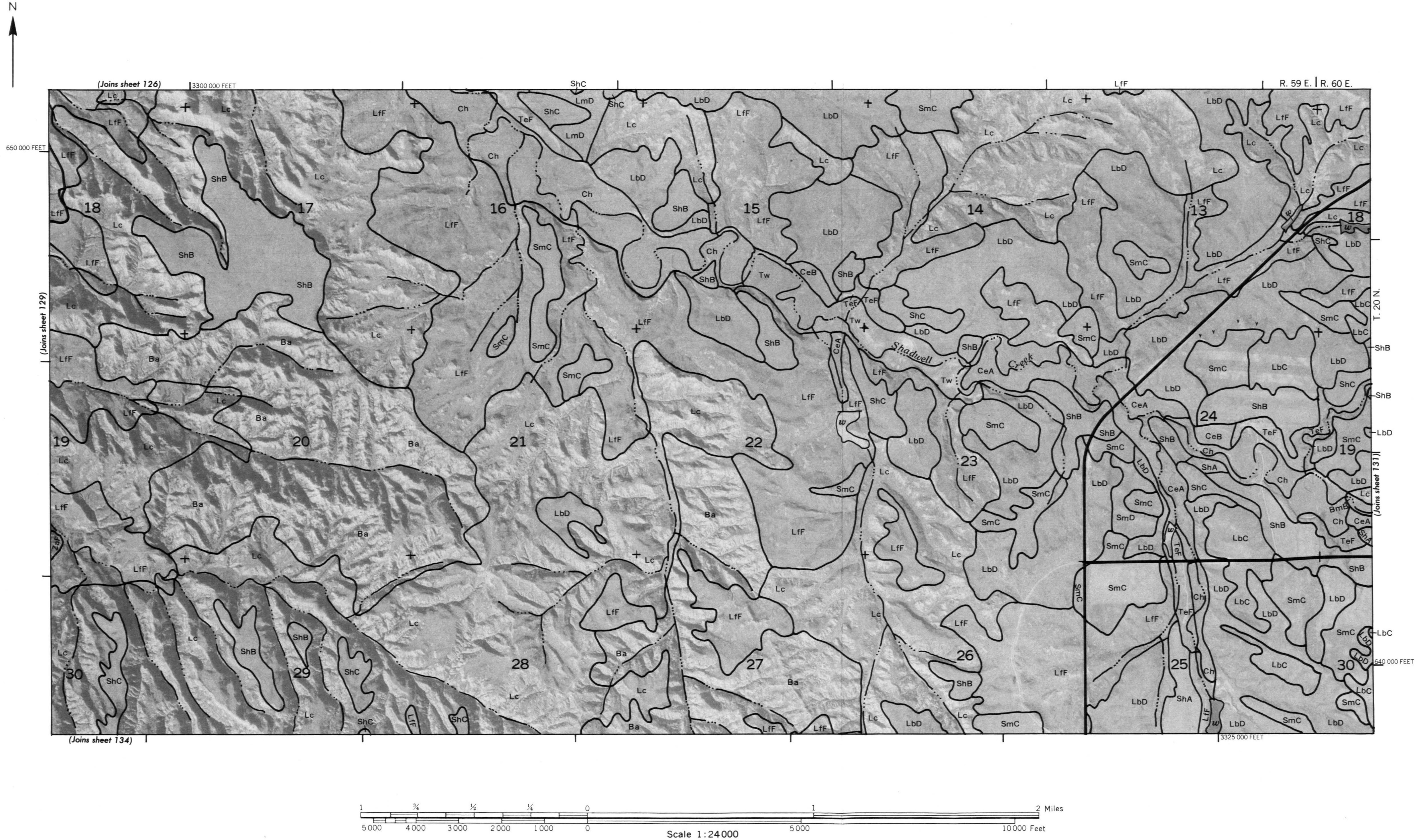
1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

RICHLAND COUNTY, MONTANA — SHEET NUMBER 130



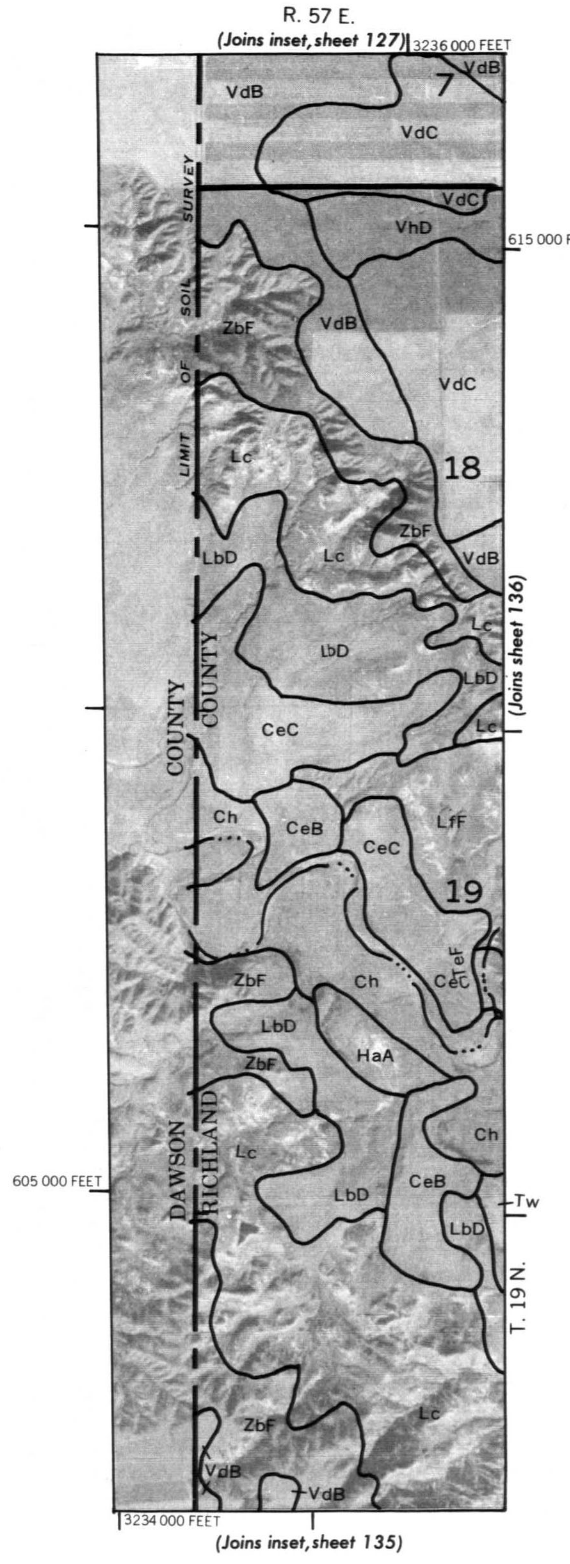
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 130

131

N



2000 AND 5000-FOOT GRID TICKS

RICHLAND COUNTY, MONTANA NO. 131

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

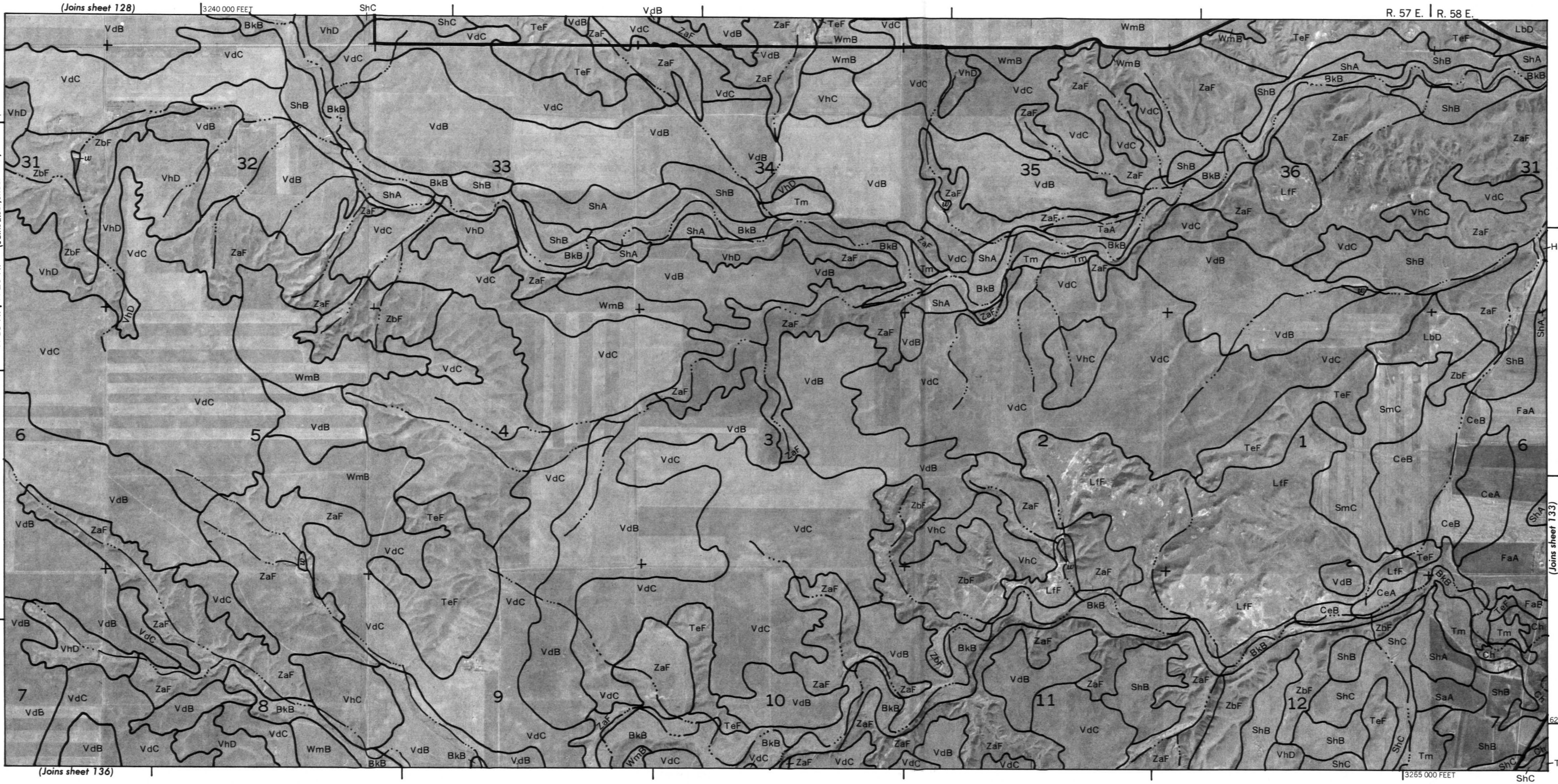
1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

N

RICHLAND COUNTY, MONTANA — SHEET NUMBER 132



1 ¾ ½ ¼ 0 1 2 Miles

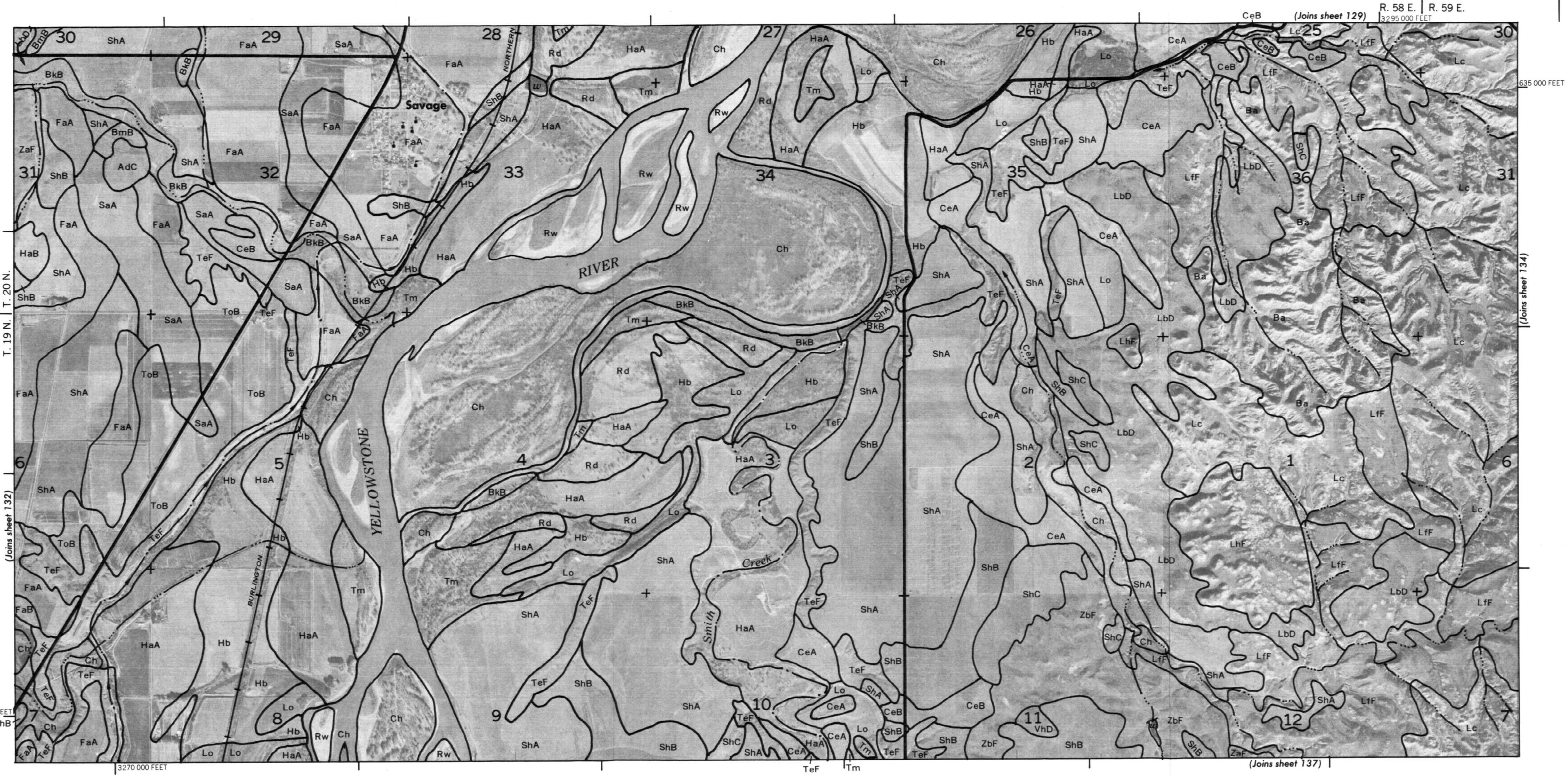
5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

133



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

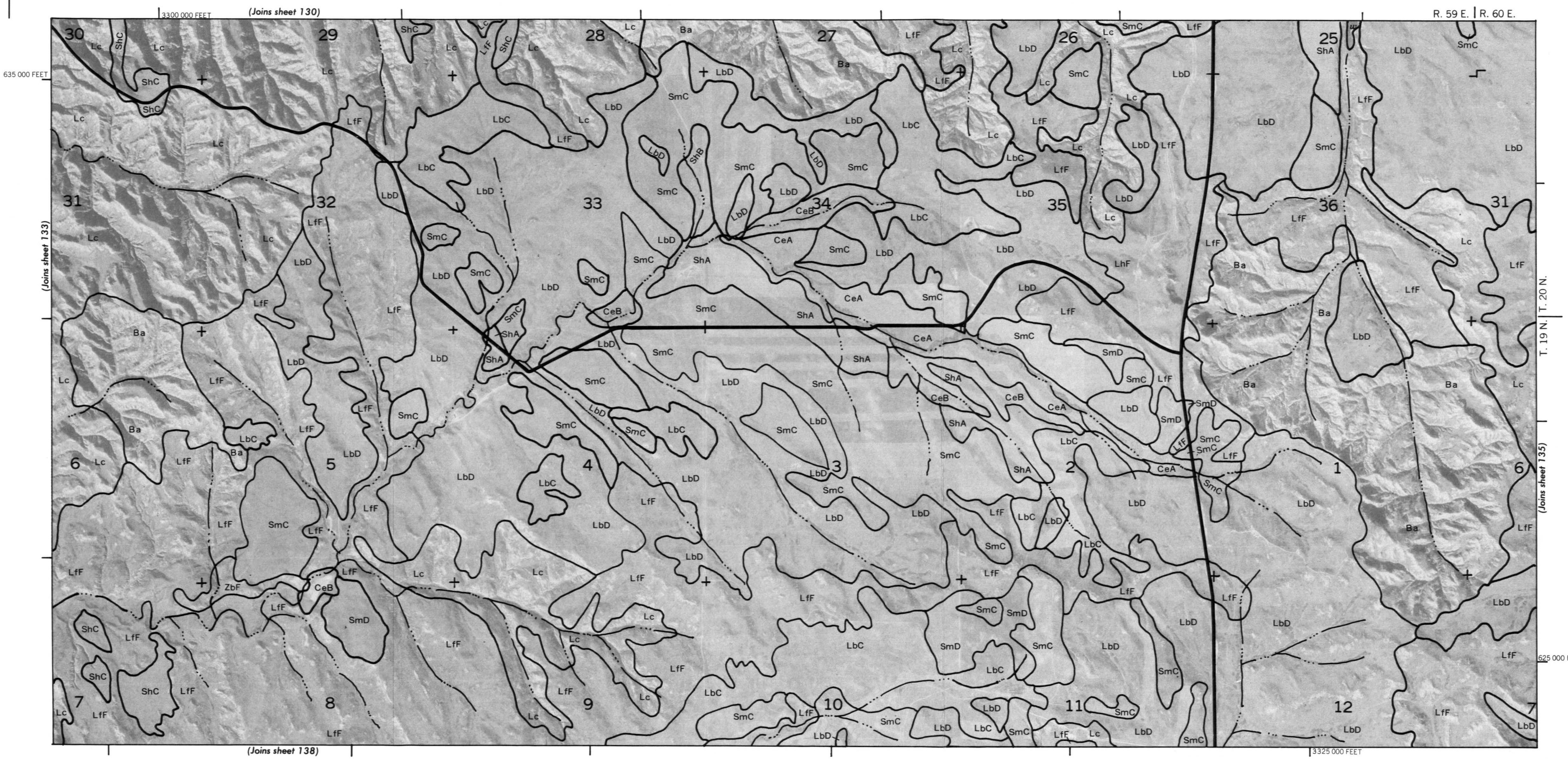
Scale 1:24000

RICHLAND COUNTY, MONTANA NO. 133

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

RICHLAND COUNTY, MONTANA — SHEET NUMBER 134

N



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

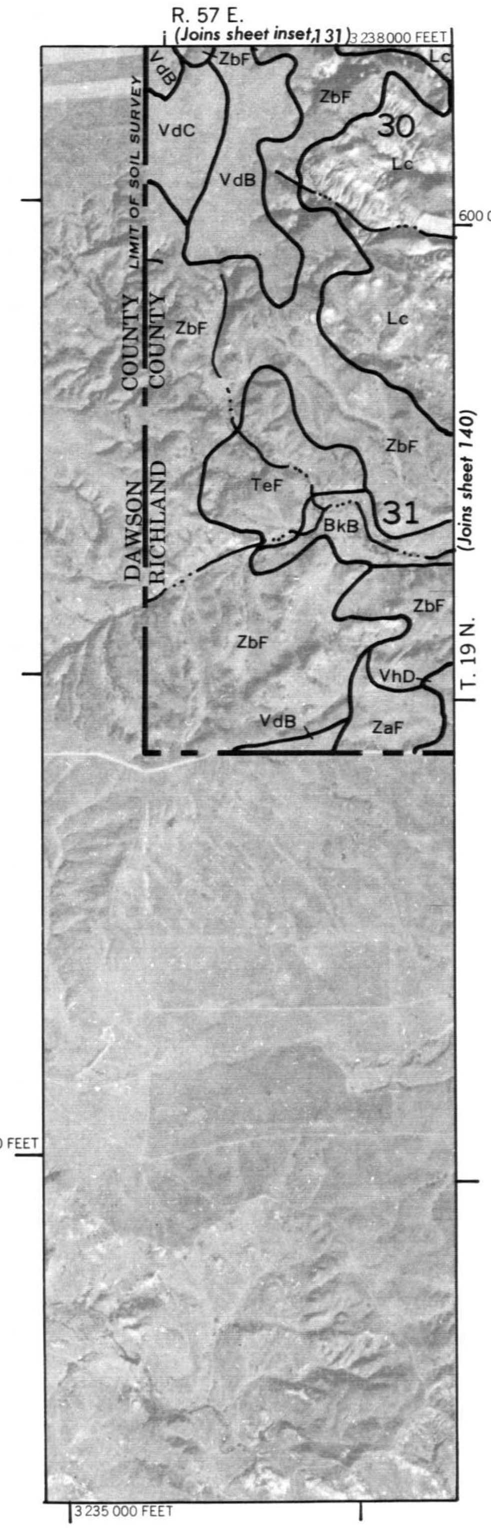
Scale 1:24000

5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

RICHLAND COUNTY, MONTANA NO. 135

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned



N

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

N

RICHLAND COUNTY, MONTANA — SHEET NUMBER 136

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

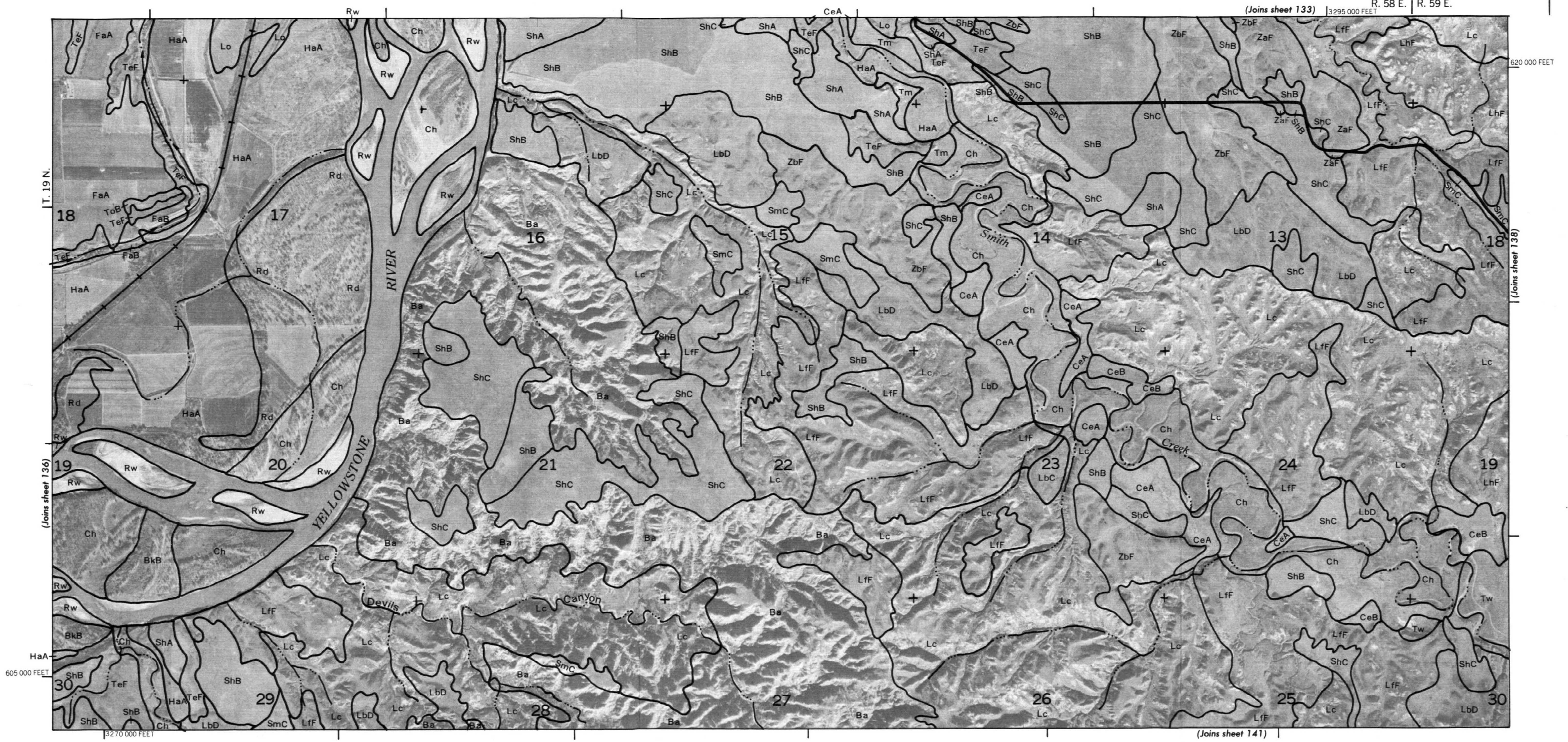
RICHLAND COUNTY, MONTANA NO. 136

137

N

RICHLAND COUNTY, MONTANA NO. 137

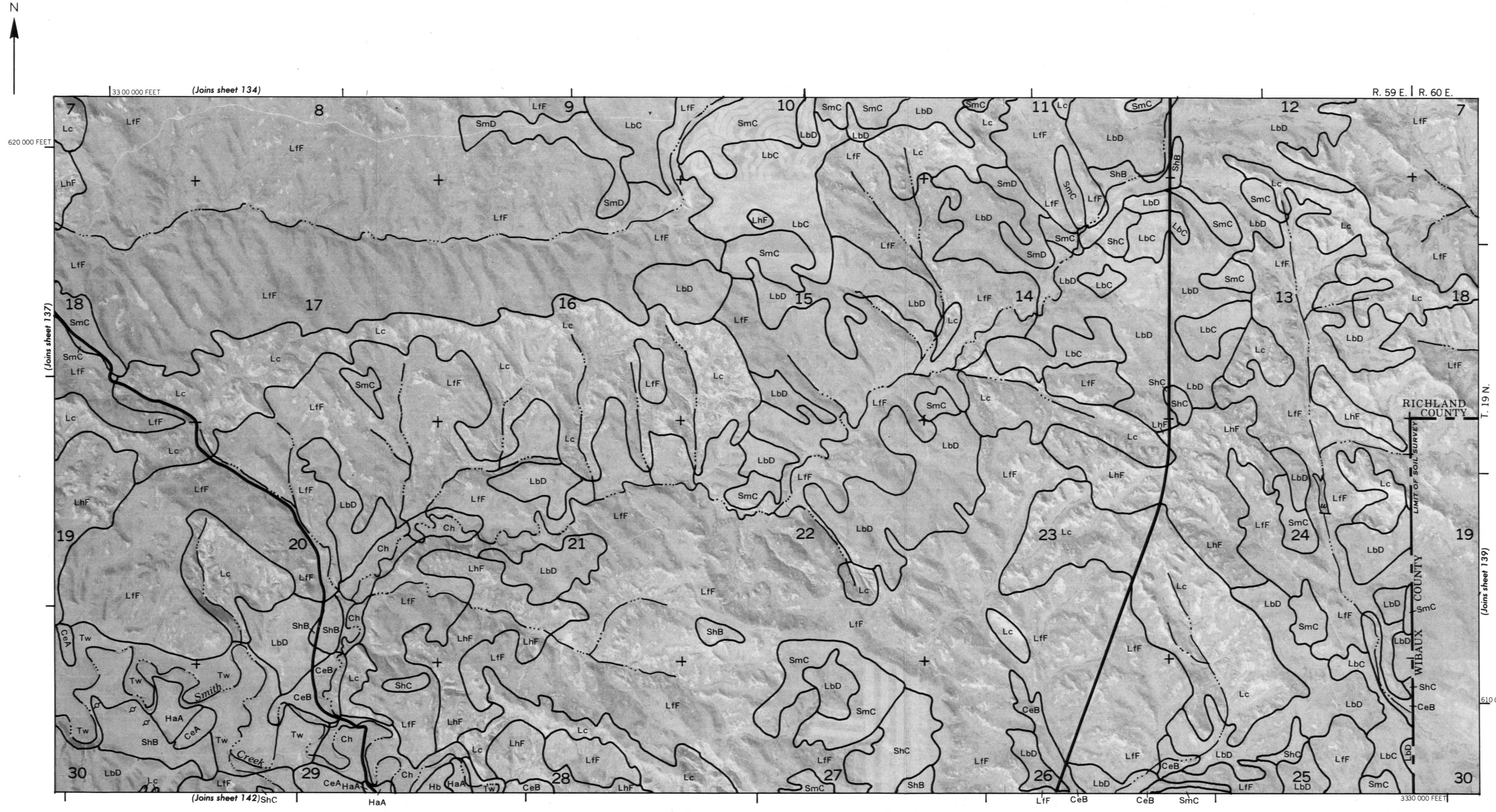
This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



1	¾	½	¼	0		1		2 Miles	
5000	4000	3000	2000	1000	0	5000		10000 Feet	

Scale 1:24 000

RICHLAND COUNTY, MONTANA — SHEET NUMBER 138



Scale 1:24000

1 ¾ ½ ¼ 0 1 2 Miles

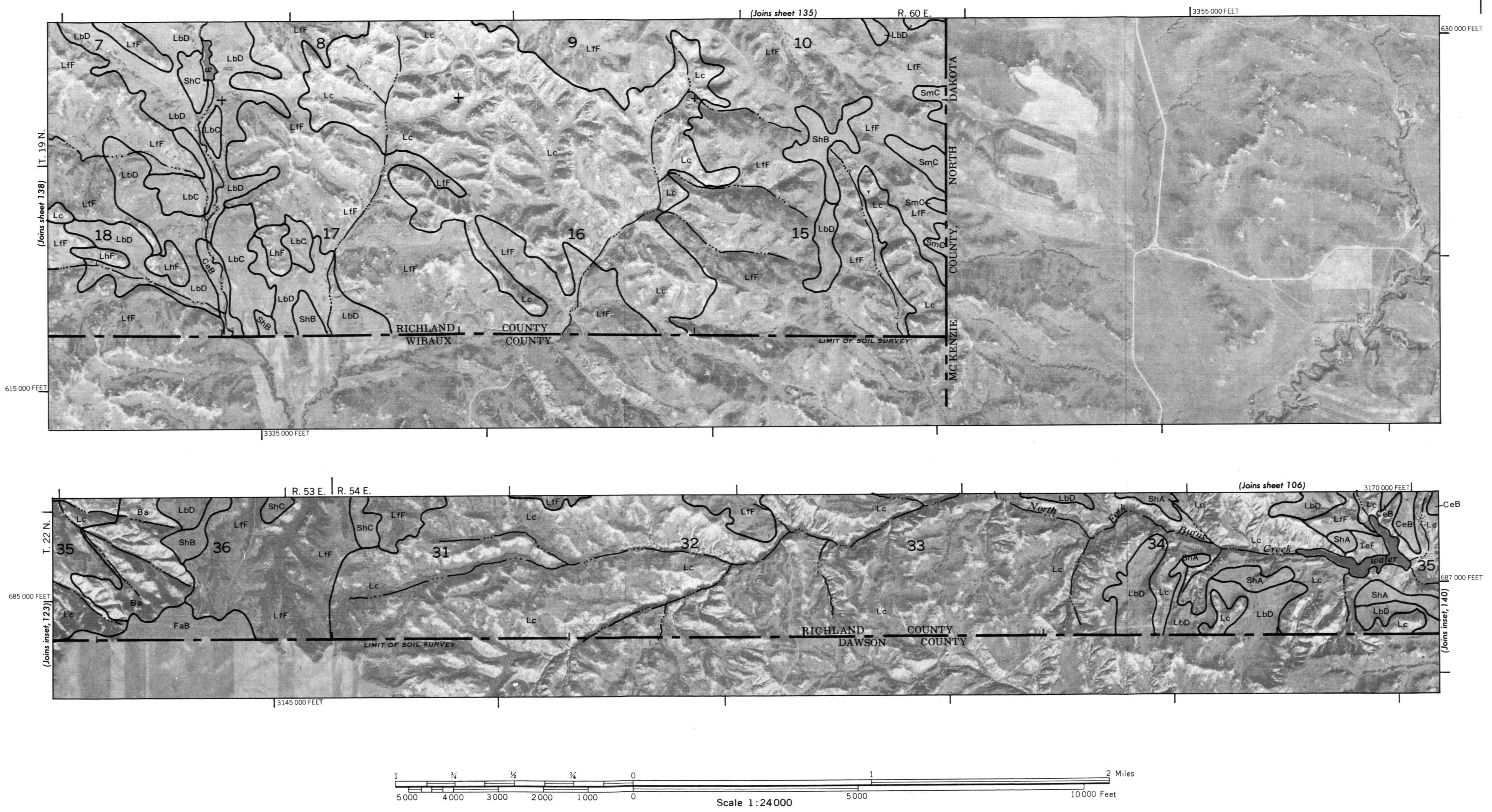
5000 4000 3000 2000 1000 0 5000 10000 Feet

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.
This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

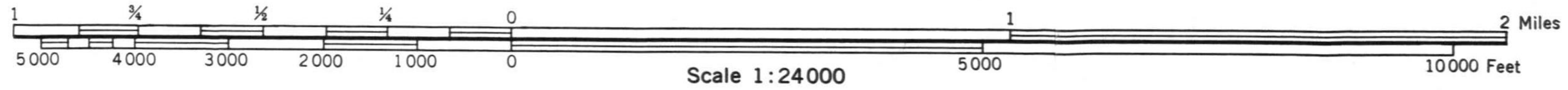
N

RICHLAND COUNTY, MONTANA NO. 139

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



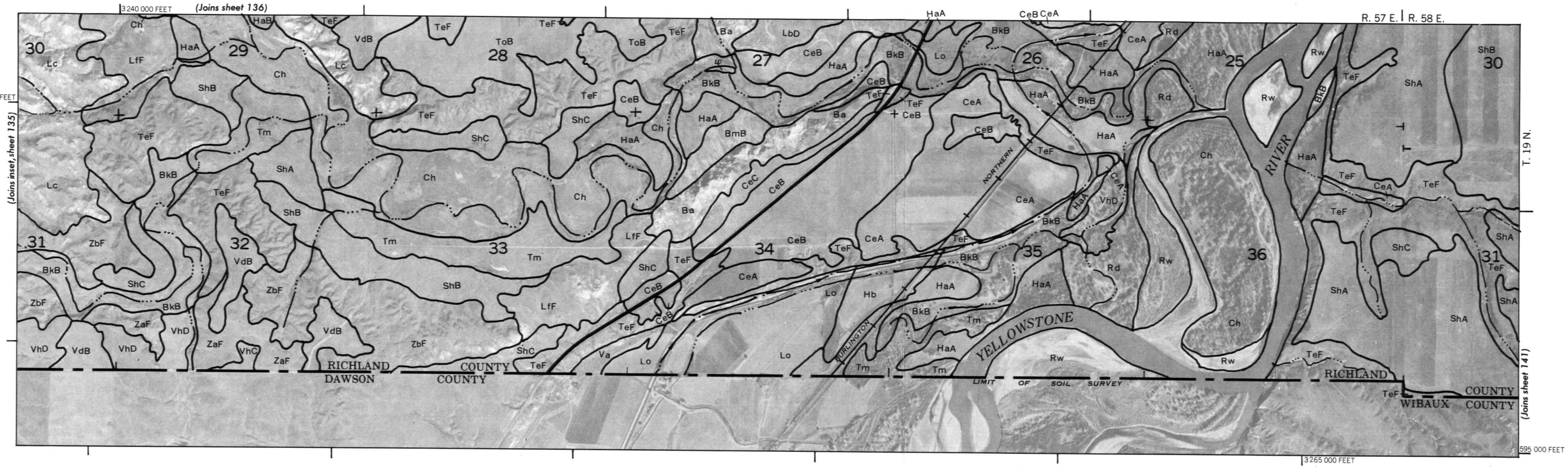
RICHLAND COUNTY, MONTANA — SHEET NUMBER 14

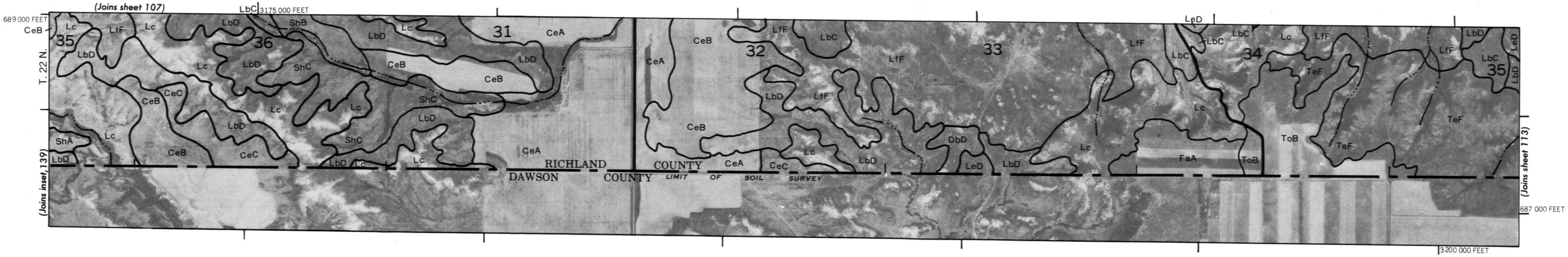


5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA — SHEET NUMBER 140





2000 AND 5000-FOOT GRID TICKS

1 ¾ ½ ¼ 0 1 2 Miles

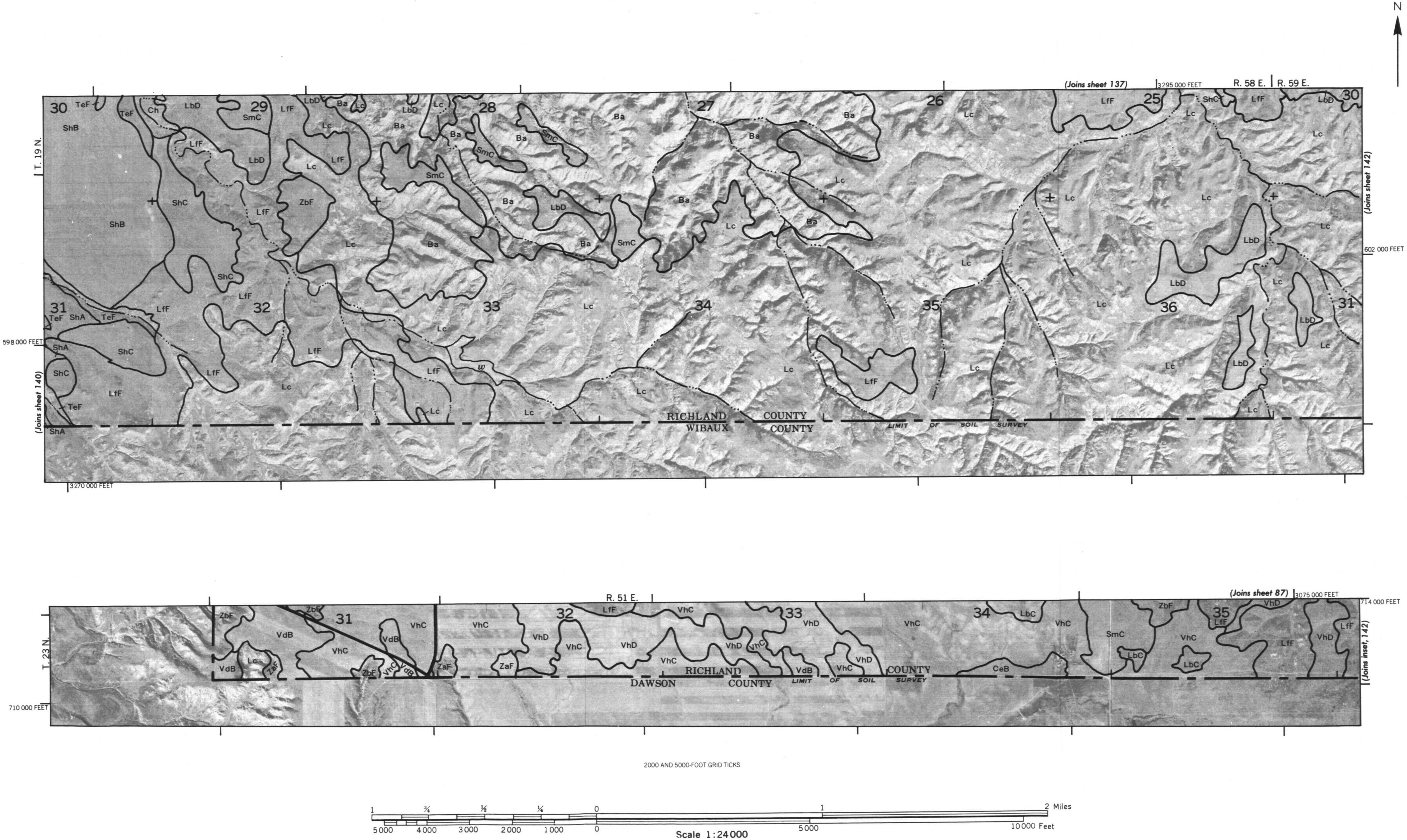
5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

Scale 1:24000

5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA — SHEET NUMBER 141

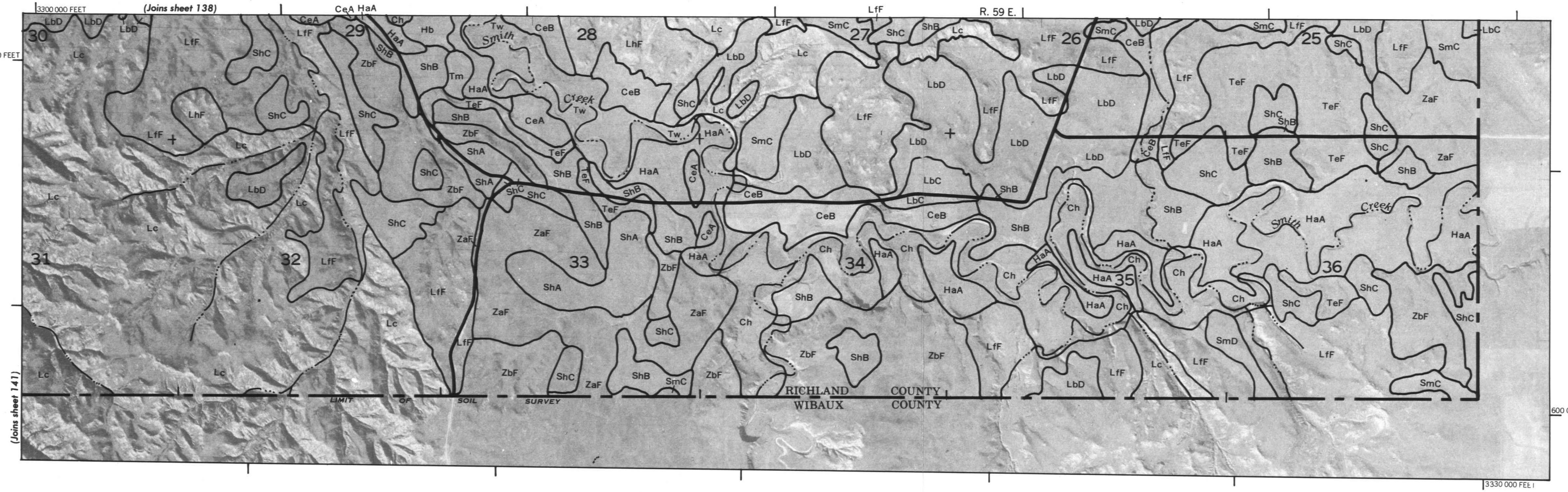


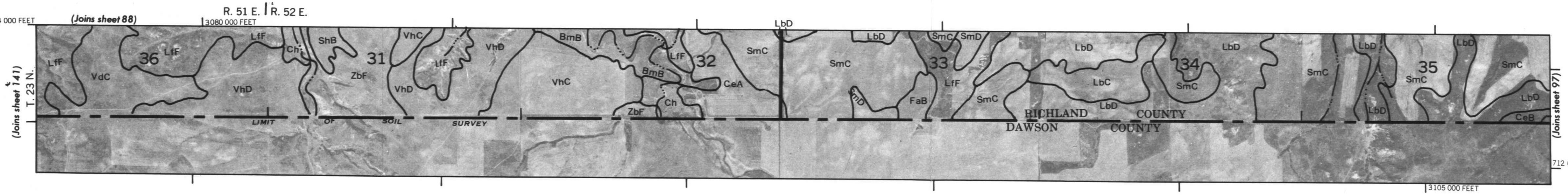
RICHLAND COUNTY, MONTANA NO. 141

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

N

RICHLAND COUNTY, MONTANA — SHEET NUMBER 142





2000 AND 5000-FOOT GRID TICKS

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

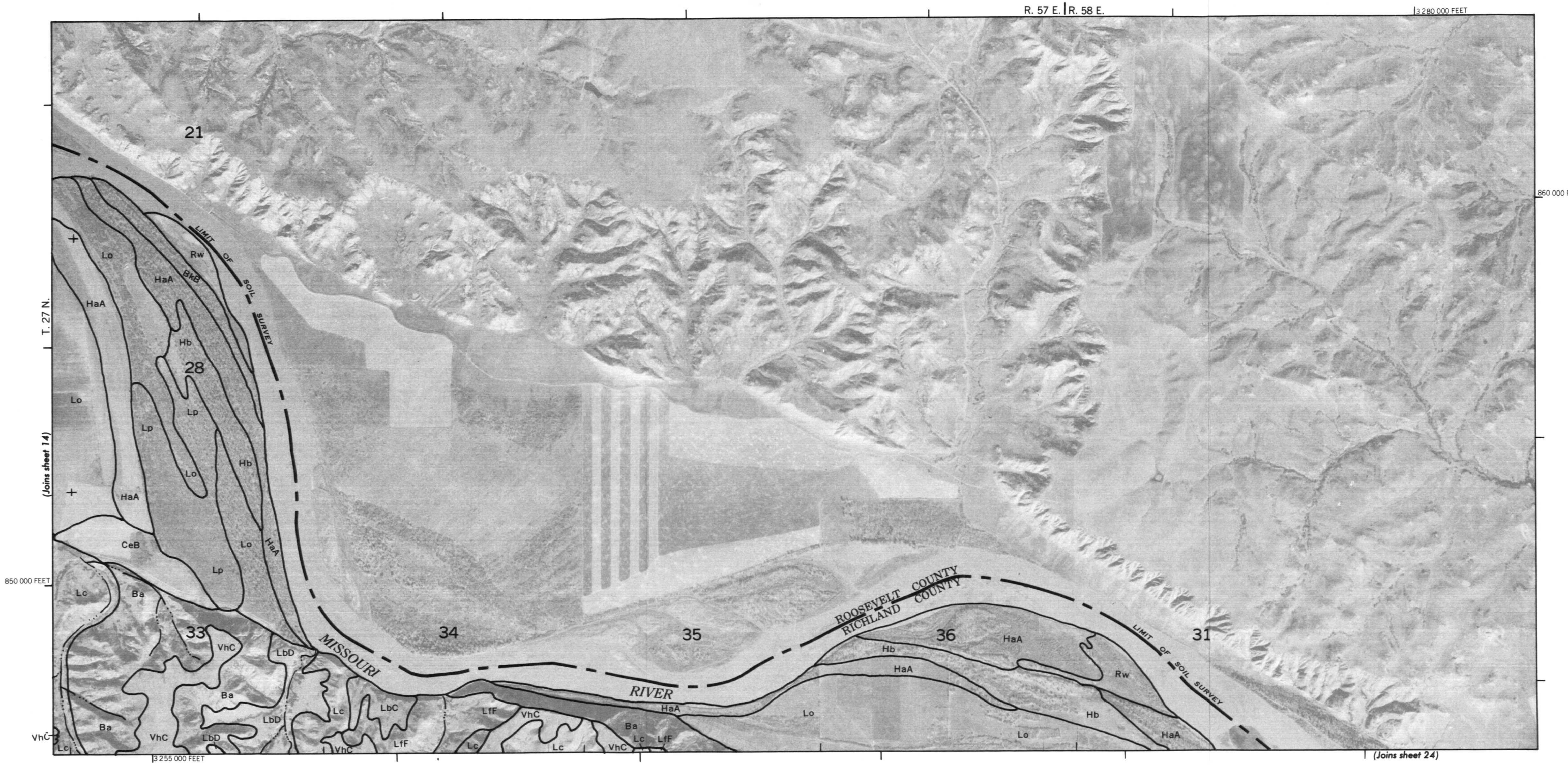
This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

15

N

RICHLAND COUNTY, MONTANA NO. 15

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

16

N

RICHLAND COUNTY, MONTANA — SHEET NUMBER 16

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

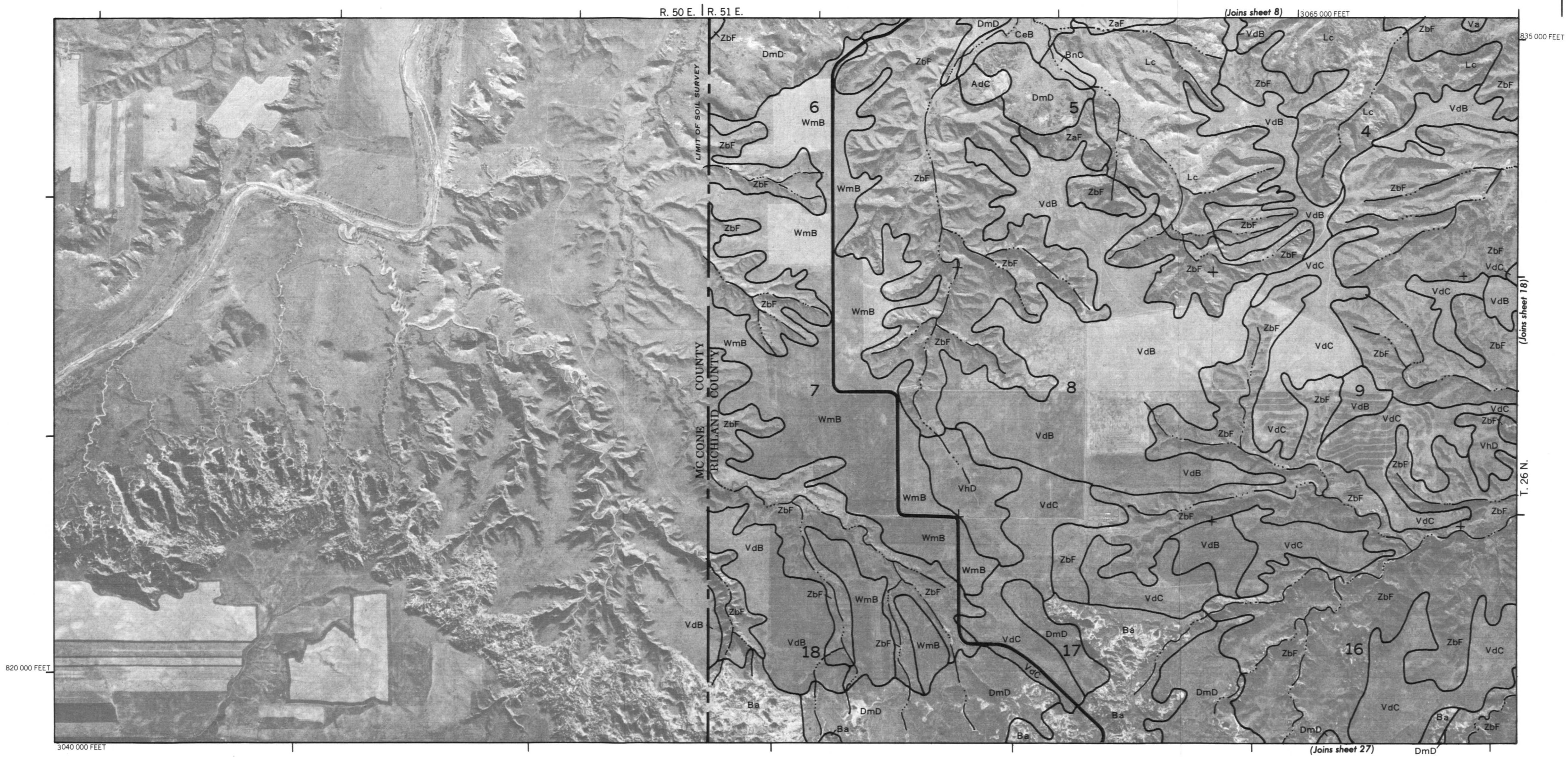
This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 16

17

N

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



1 ¾ ½ ¼ 0 1 2 Miles

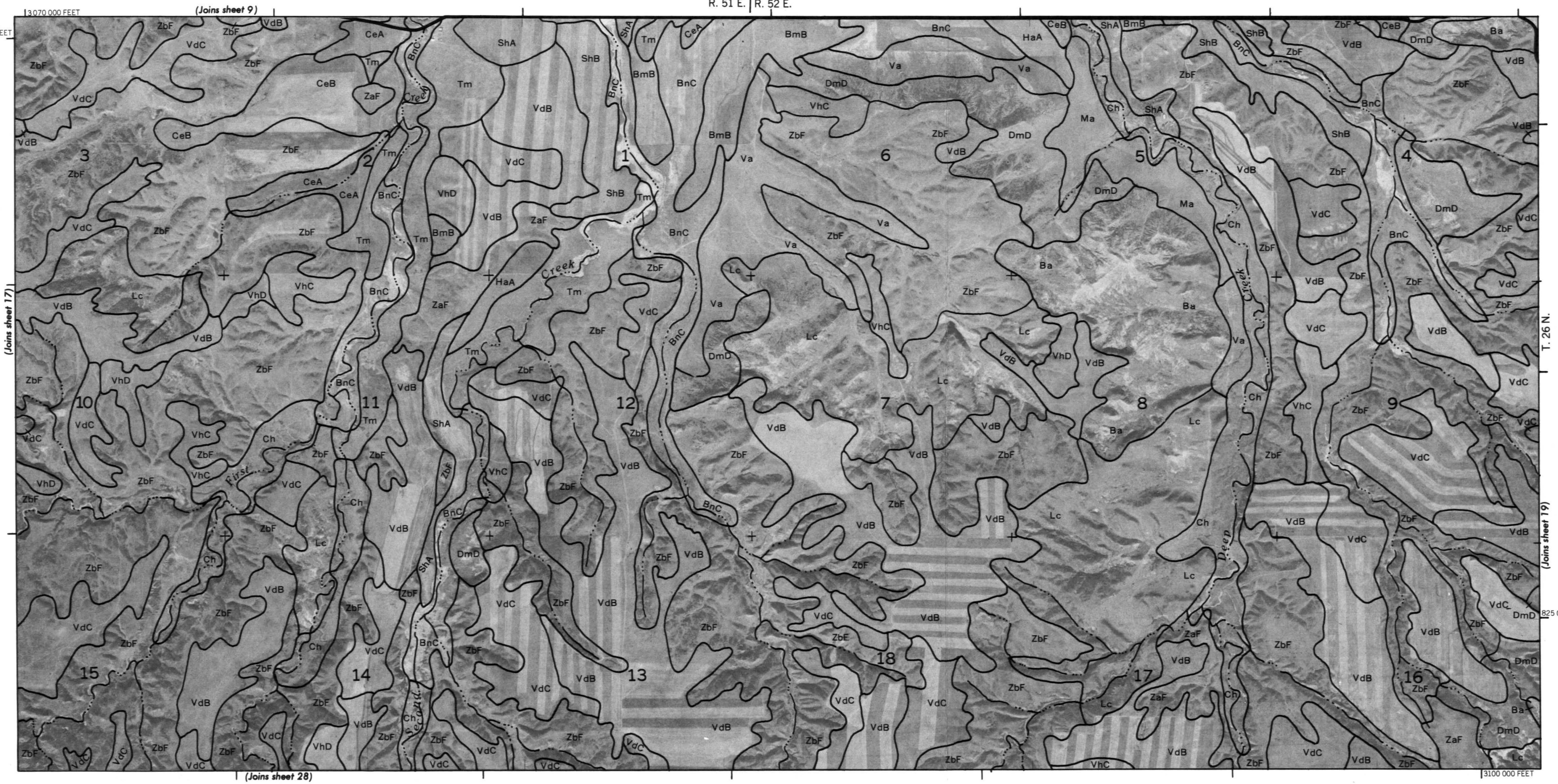
5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

18

N

RICHLAND COUNTY, MONTANA — SHEET NUMBER 18



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 18

N

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. 5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

N

RICHLAND COUNTY, MONTANA — SHEET NUMBER 20

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 20

N

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

22

N

RICHLAND COUNTY, MONTANA — SHEET NUMBER 22

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

Scale 1:24 000

5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 22

N

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

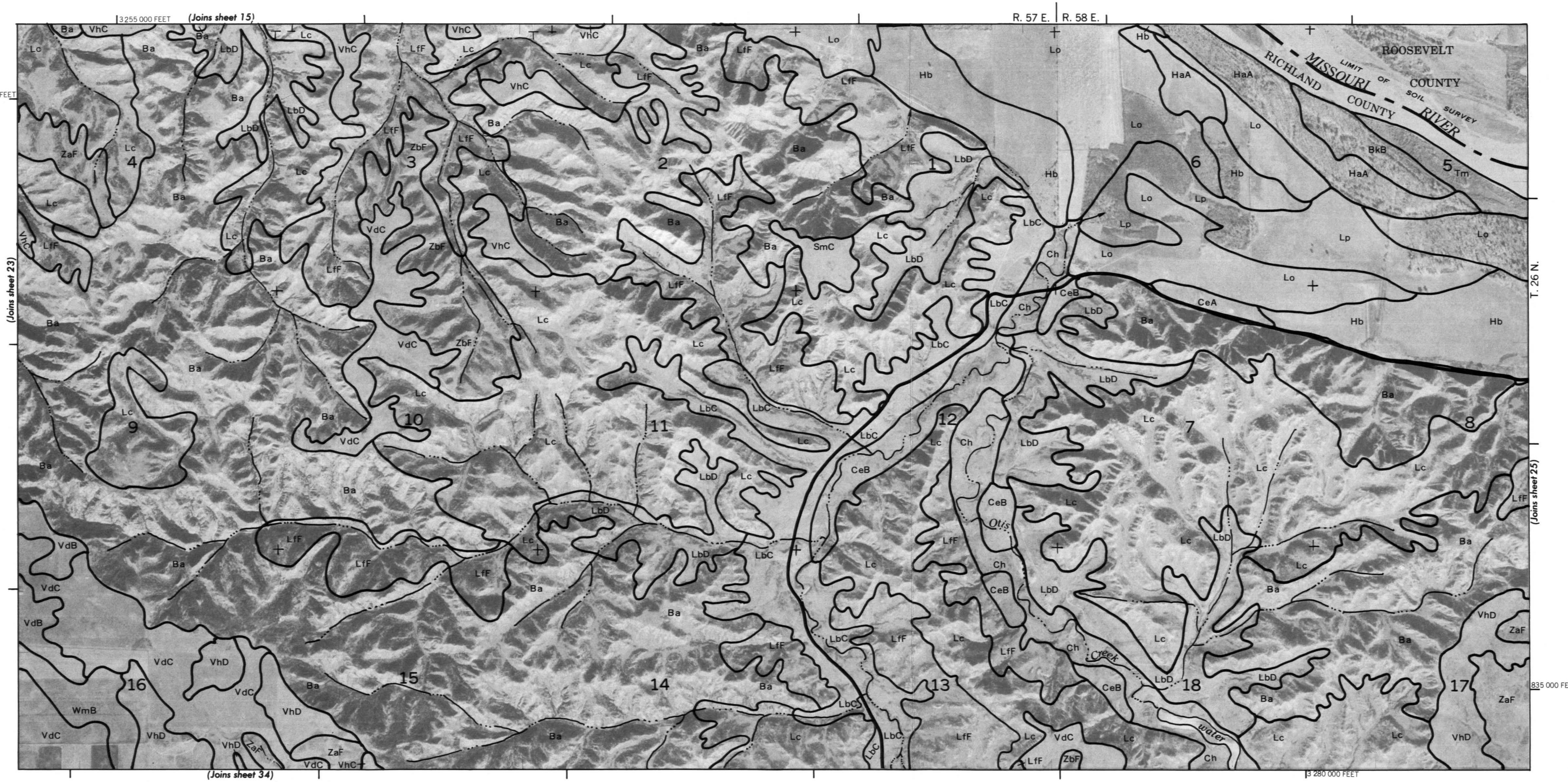
1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

RICHLAND COUNTY, MONTANA — SHEET NUMBER 24

N



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA — SHEET NUMBER 25

N

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

(26)

RICHLAND COUNTY, MONTANA — SHEET NUMBER 26

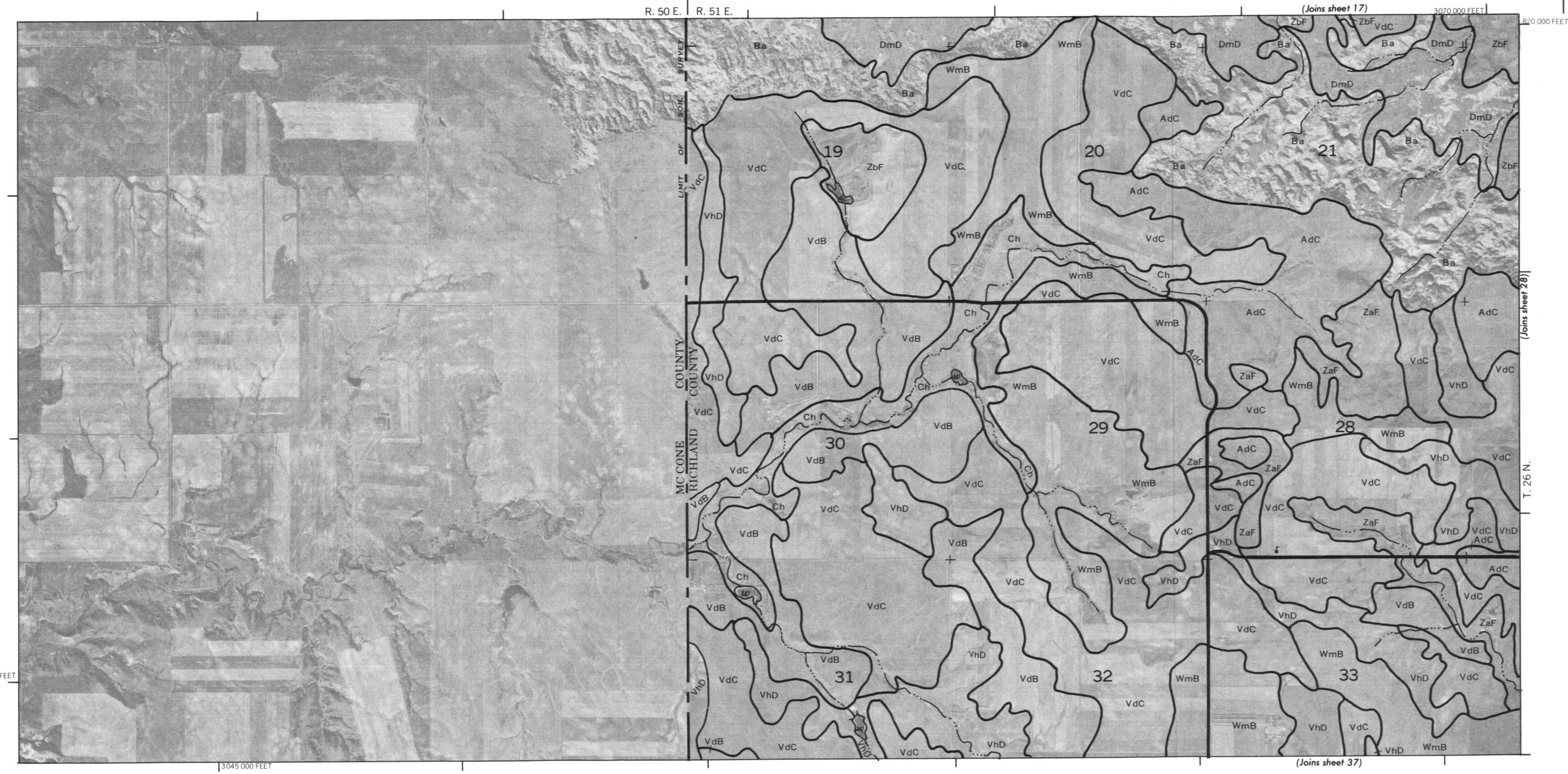
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 26

27

N



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

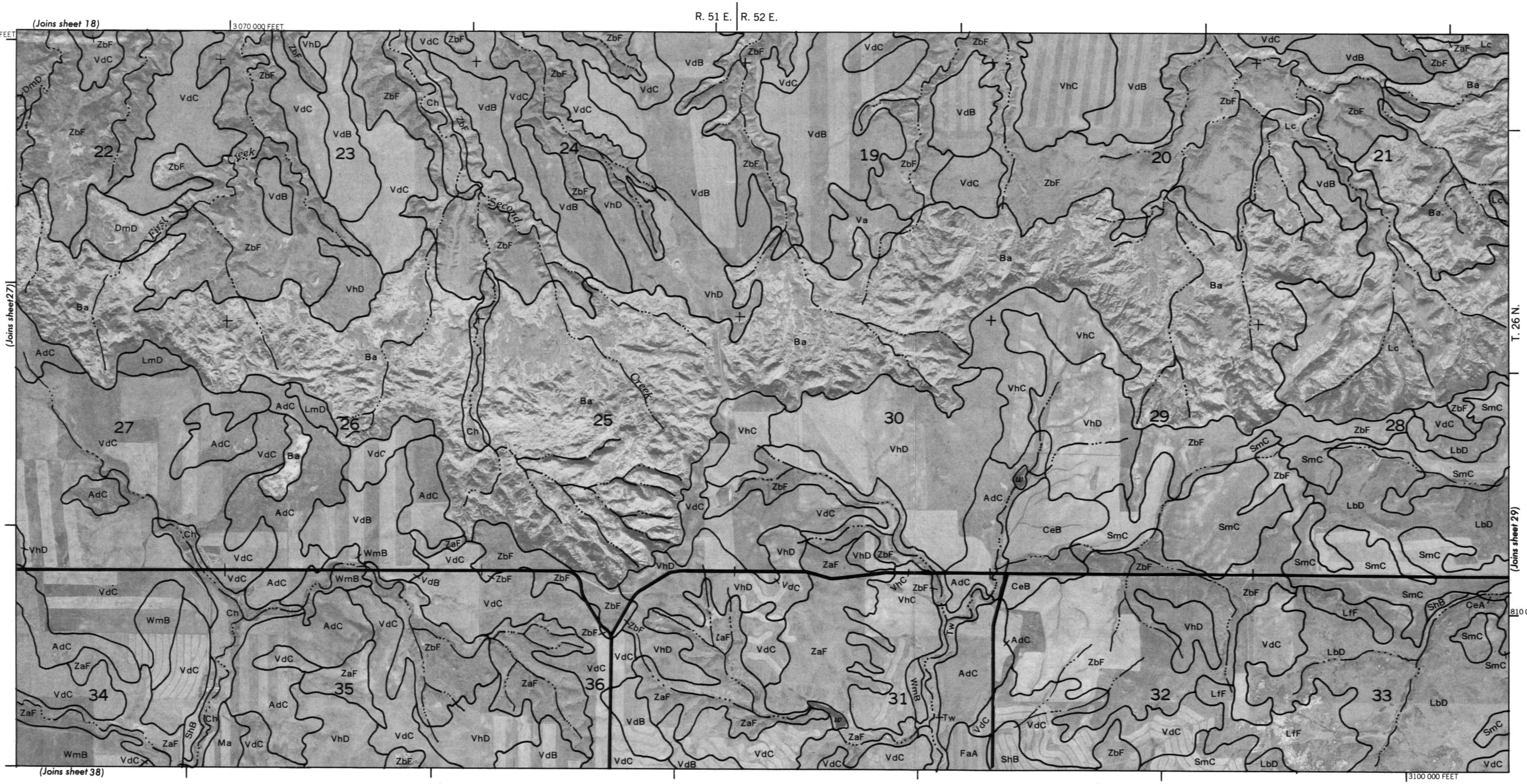
Scale 1:24000

RICHLAND COUNTY, MONTANA NO. 27

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

RICHLAND COUNTY, MONTANA — SHEET NUMBER 28

N



1 ¾ ½ ¼ 0 1 2 Miles

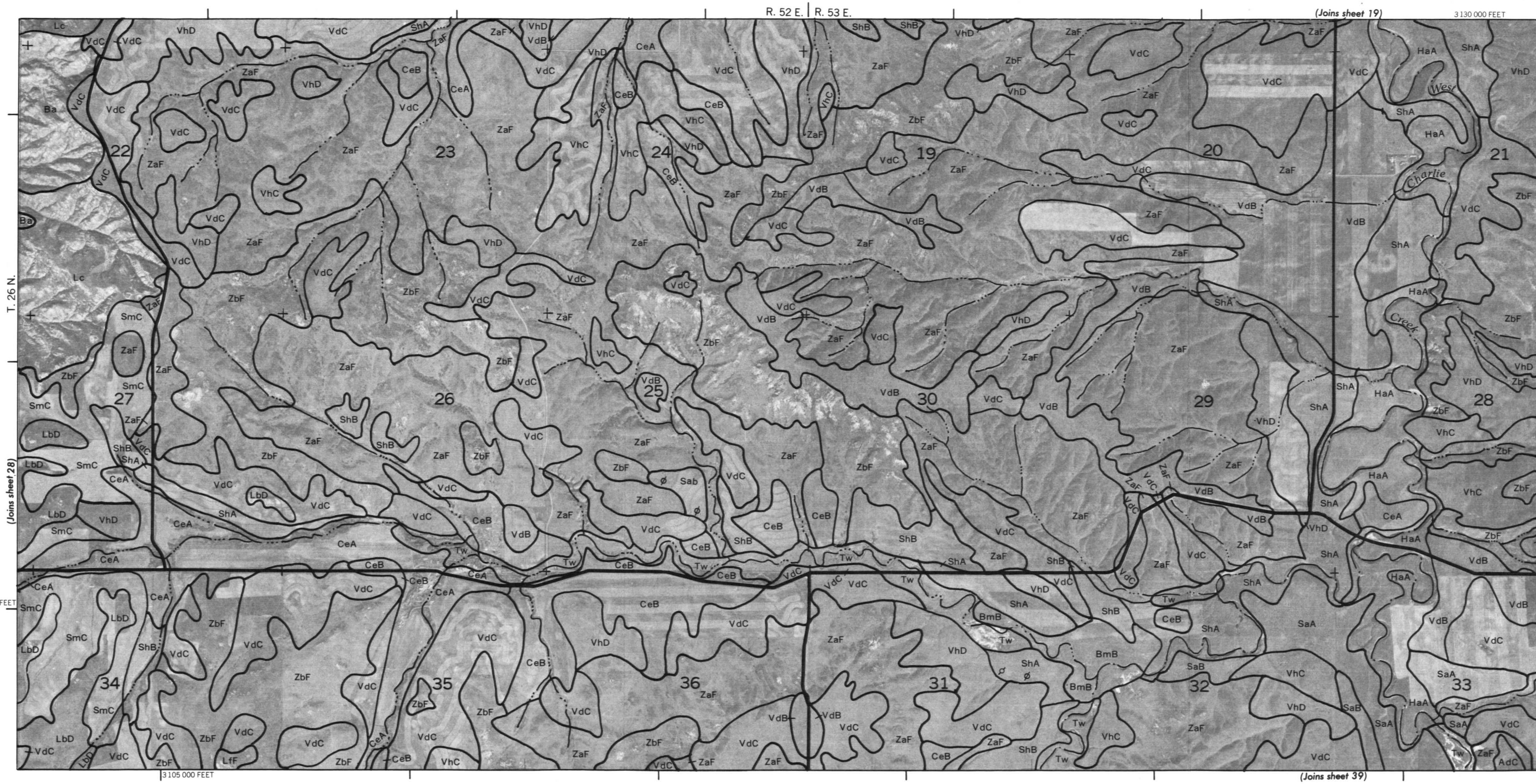
5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

Scale 1:24 000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

N



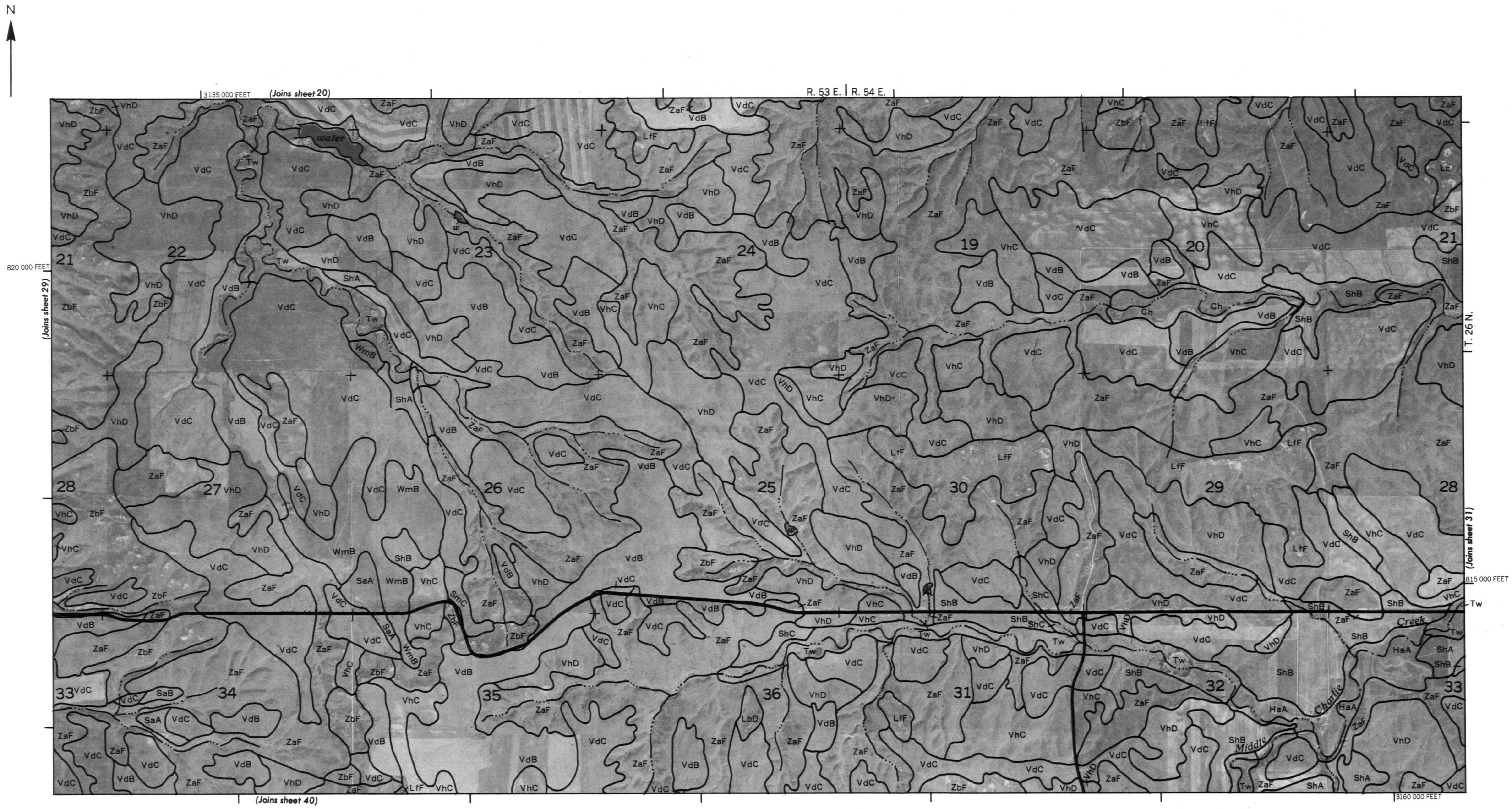
1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

RICHLAND COUNTY, MONTANA — SHEET NUMBER 30

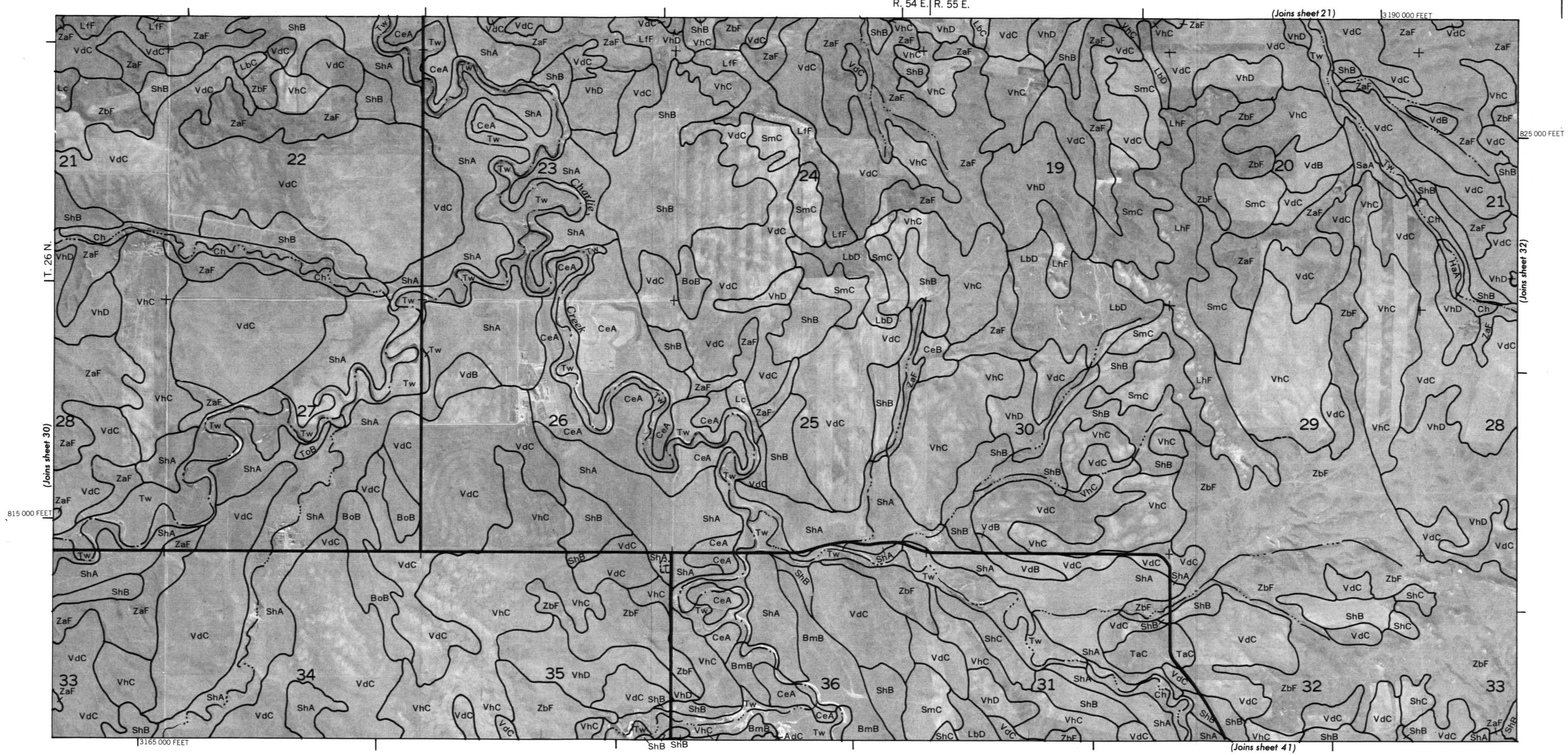


Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

N



RICHLAND COUNTY, MONTANA NO. 31

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

RICHLAND COUNTY, MONTANA — SHEET NUMBER 32

N

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

RICHLAND COUNTY, MONTANA NO. 32

33

N

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

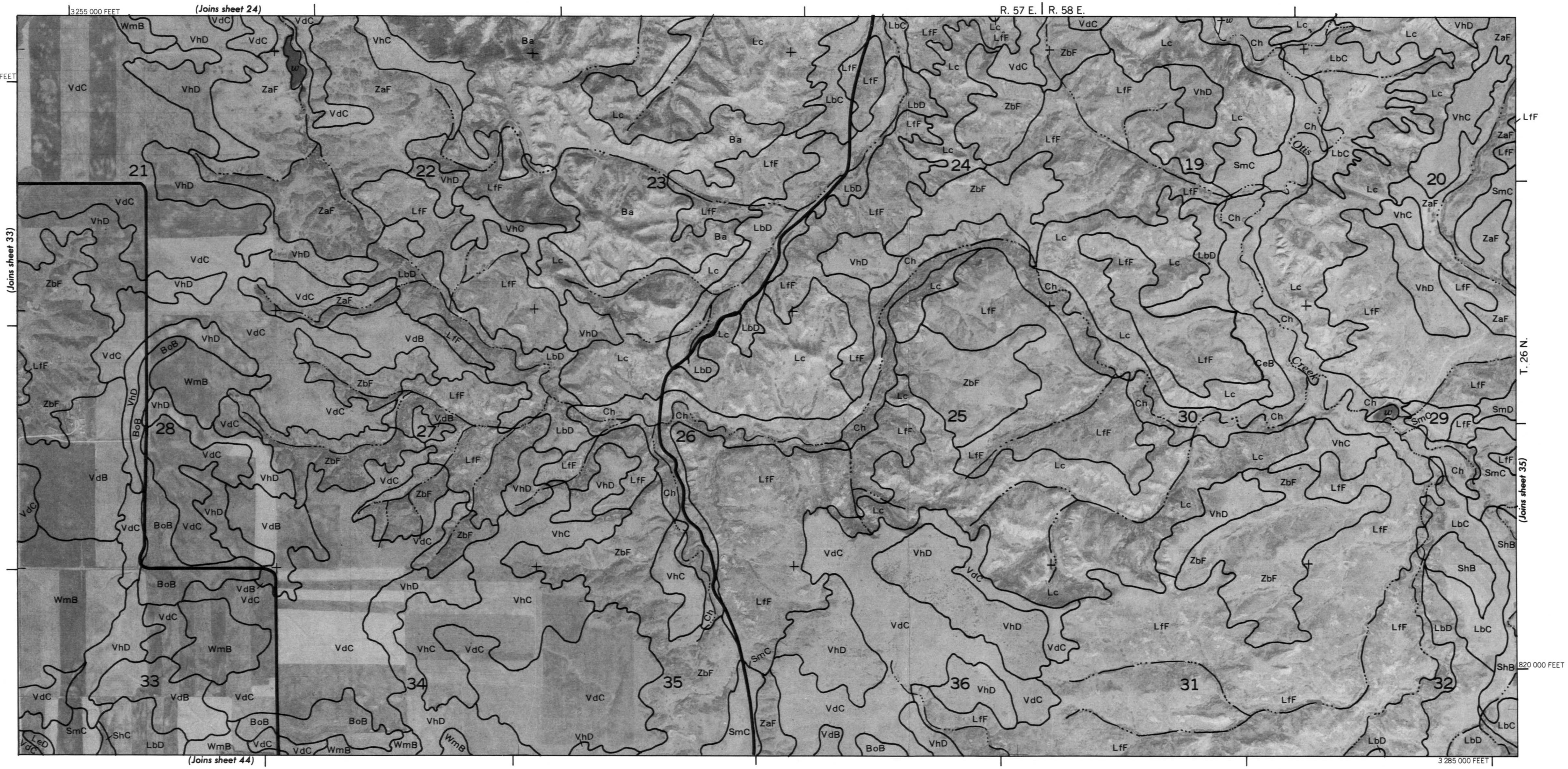
Scale 1:24000

RICHLAND COUNTY, MONTANA NO. 33

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

N

RICHLAND COUNTY, MONTANA — SHEET NUMBER 34



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 34

RICHLAND COUNTY, MONTANA — SHEET NUMBER 35

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

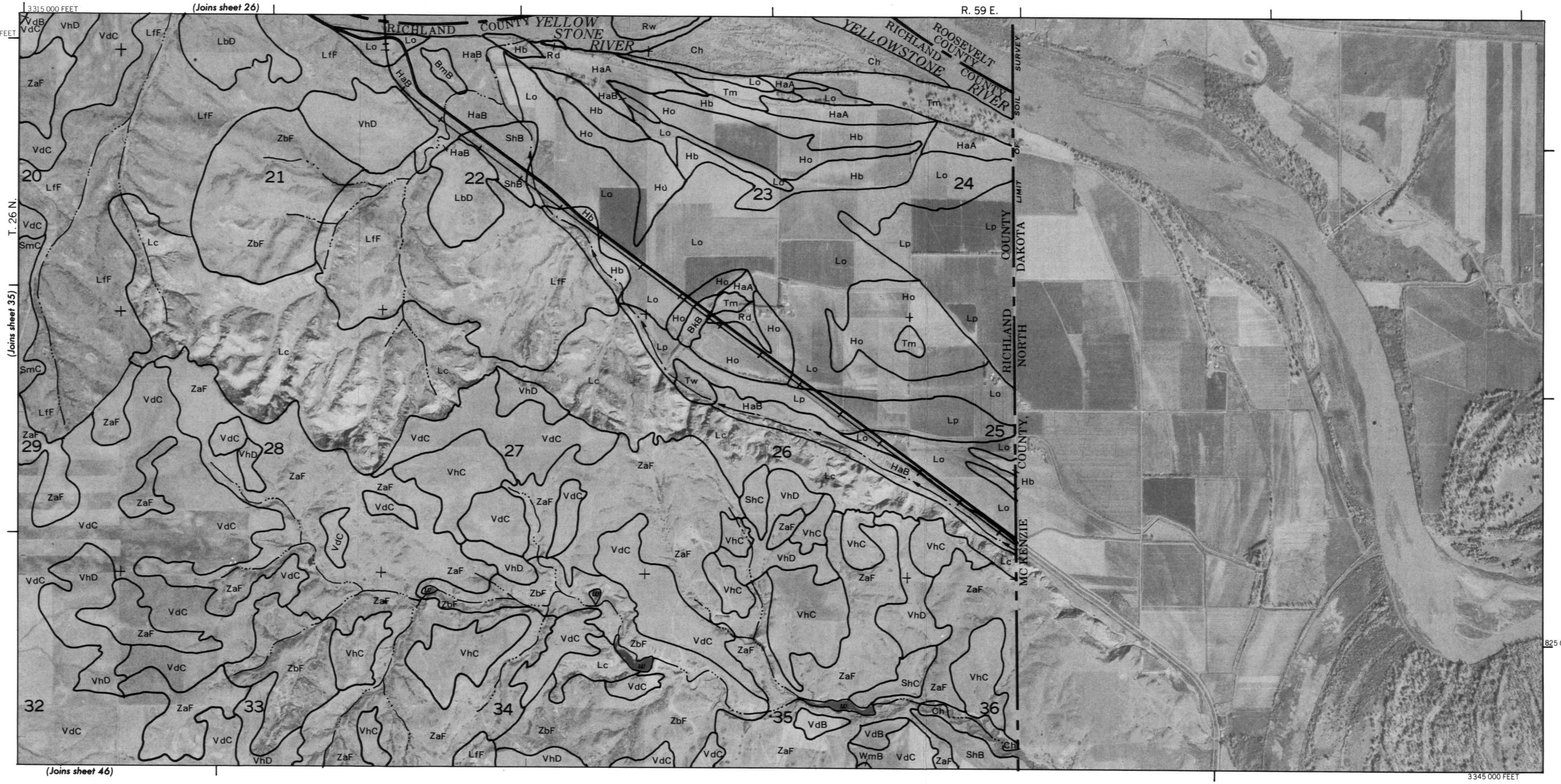
1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

N

RICHLAND COUNTY, MONTANA — SHEET NUMBER 36



1 ¾ ½ ¼ 0 1 2 Miles

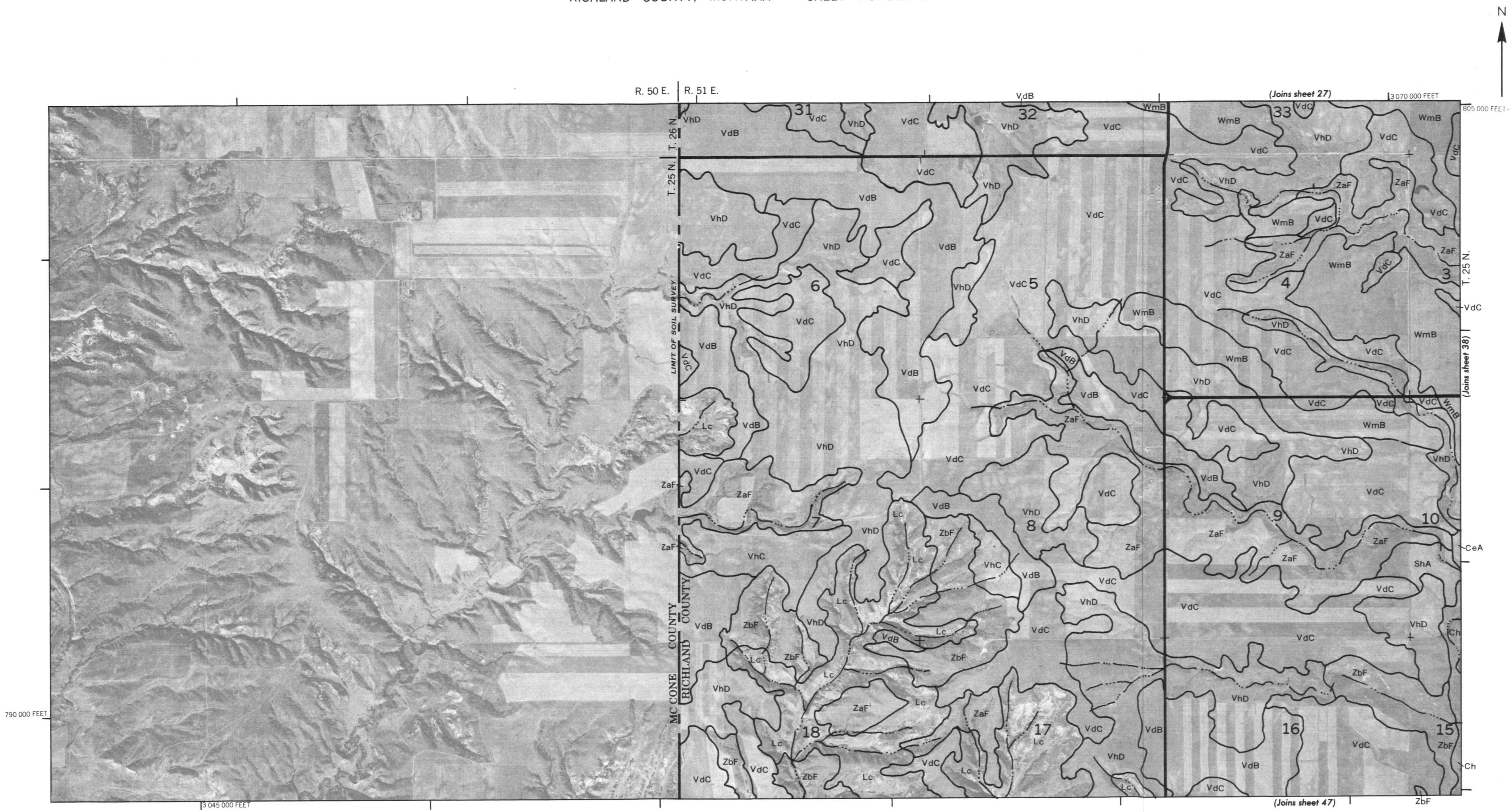
5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

37



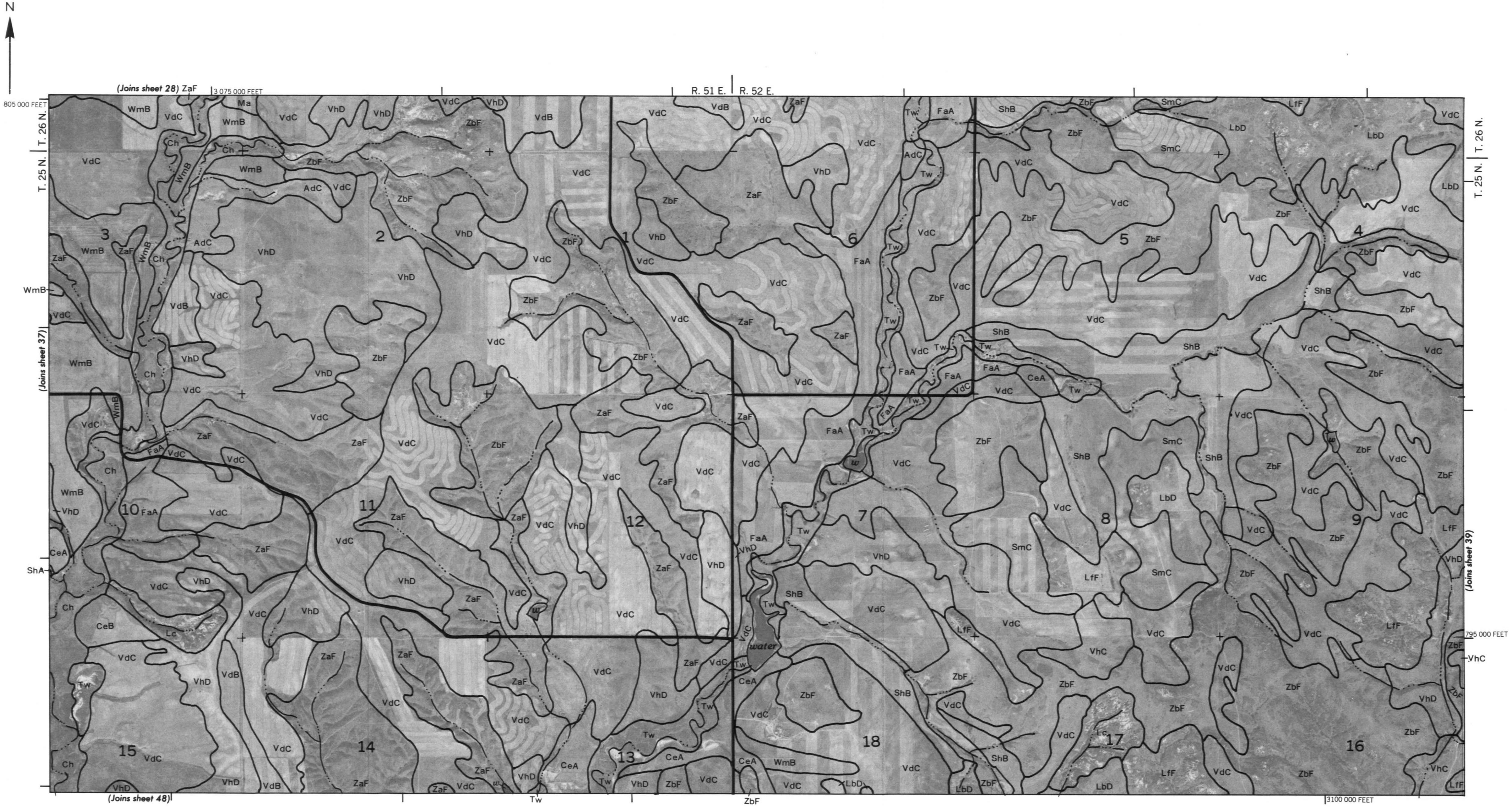
1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

RICHLAND COUNTY, MONTANA — SHEET NUMBER 38



Scale 1:24000

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

39

N

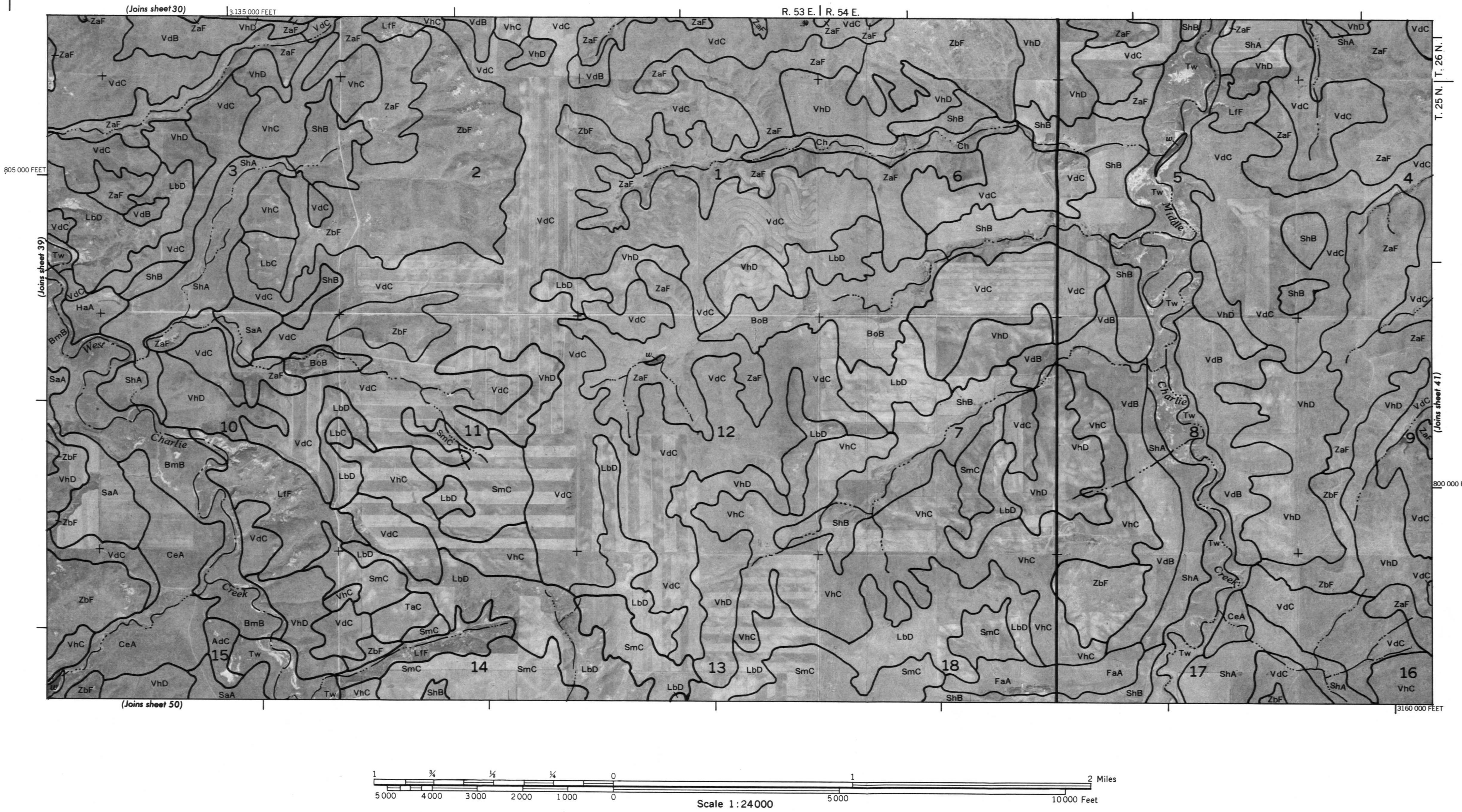
1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

RICHLAND COUNTY, MONTANA — SHEET NUMBER 40



5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 40

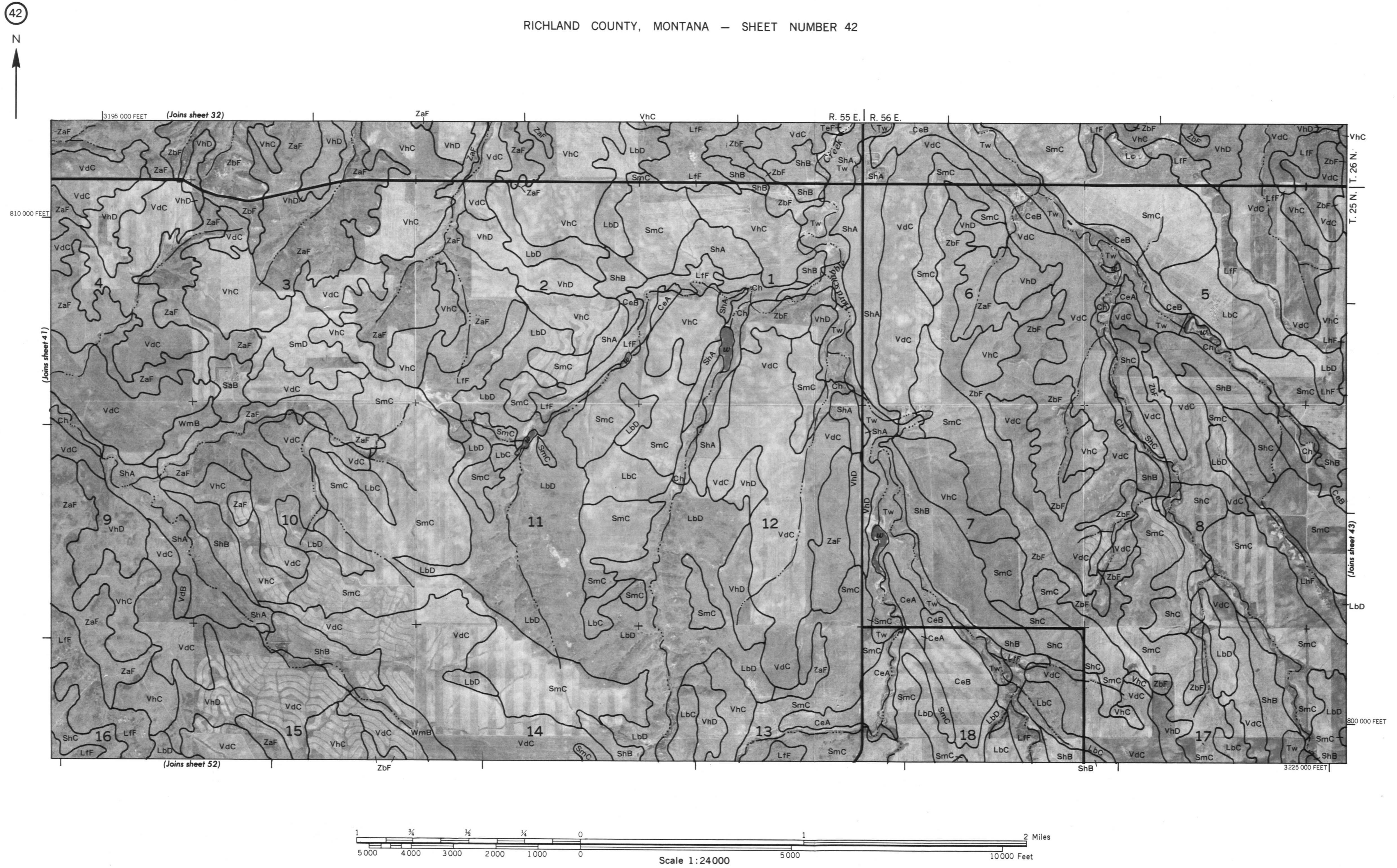
1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

RICHLAND COUNTY, MONTANA — SHEET NUMBER 42



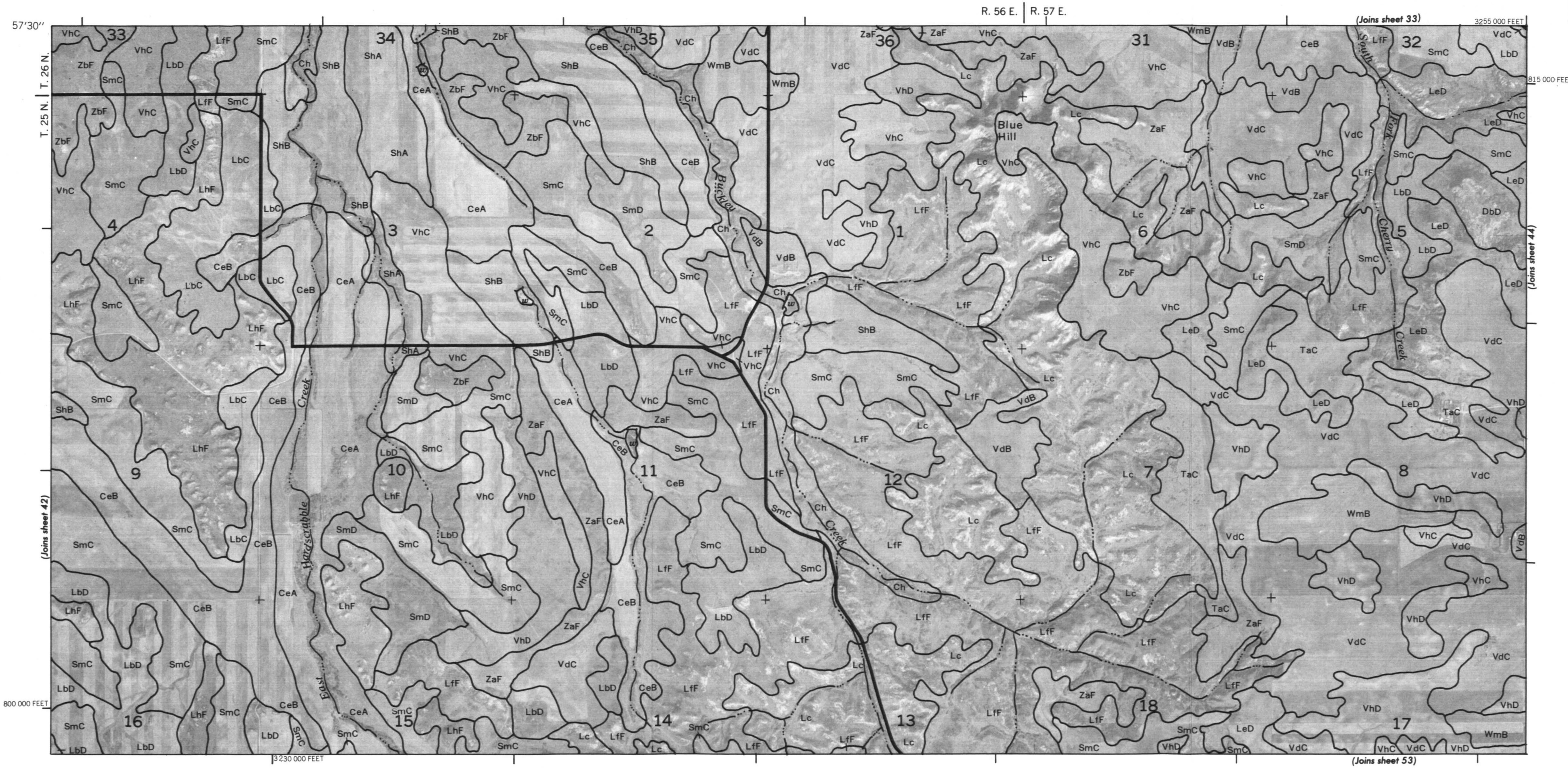
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 42

RICHLAND COUNTY, MONTANA — SHEET NUMBER 43

N



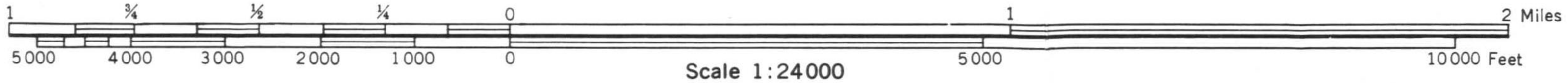
1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

RICHLAND COUNTY, MONTANA NO. 43

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

N

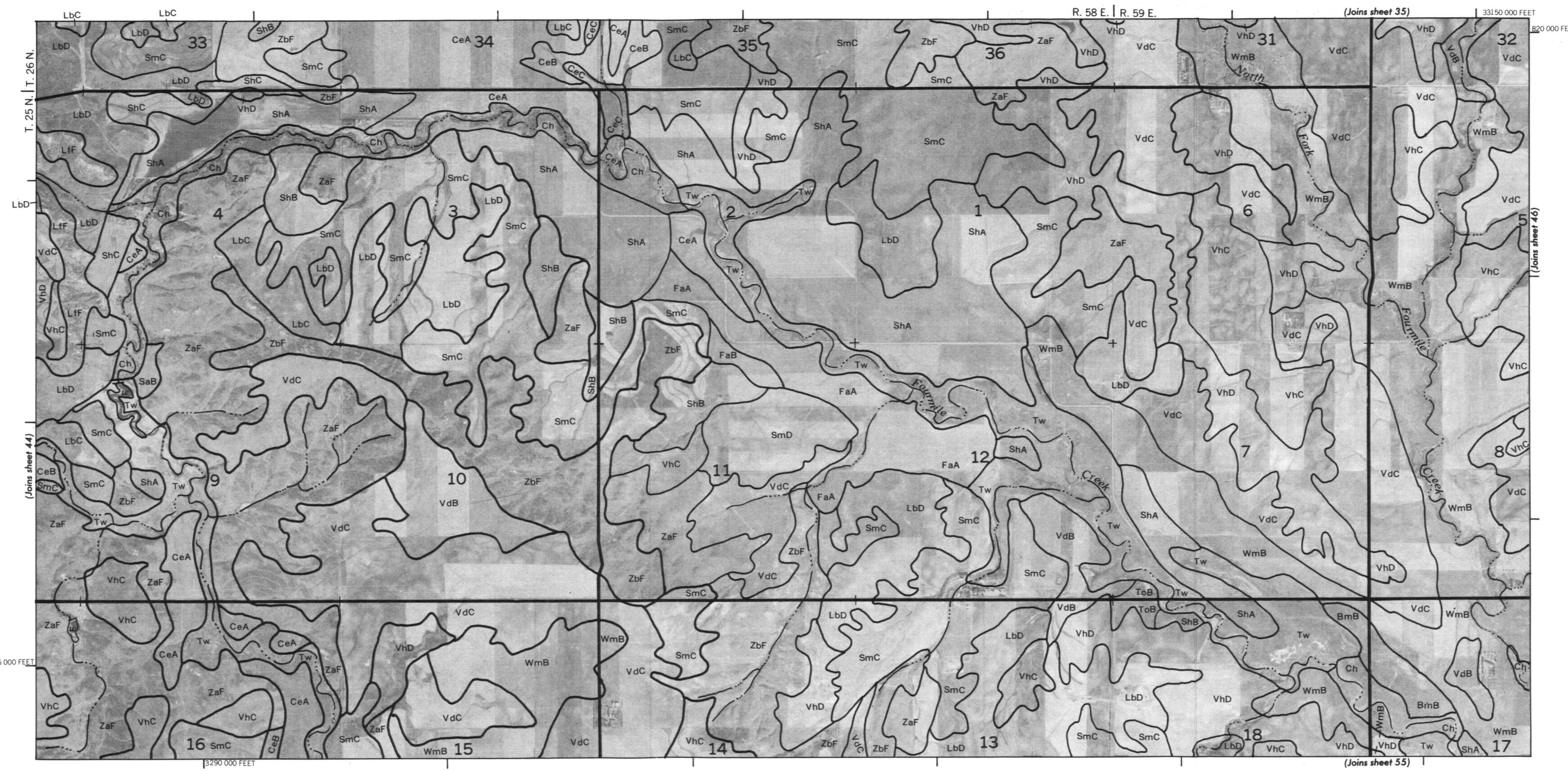
RICHLAND COUNTY, MONTANA — SHEET NUMBER 44



Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

RICHLAND COUNTY, MONTANA NO. 45

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

RICHLAND COUNTY, MONTANA — SHEET NUMBER 46

N

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

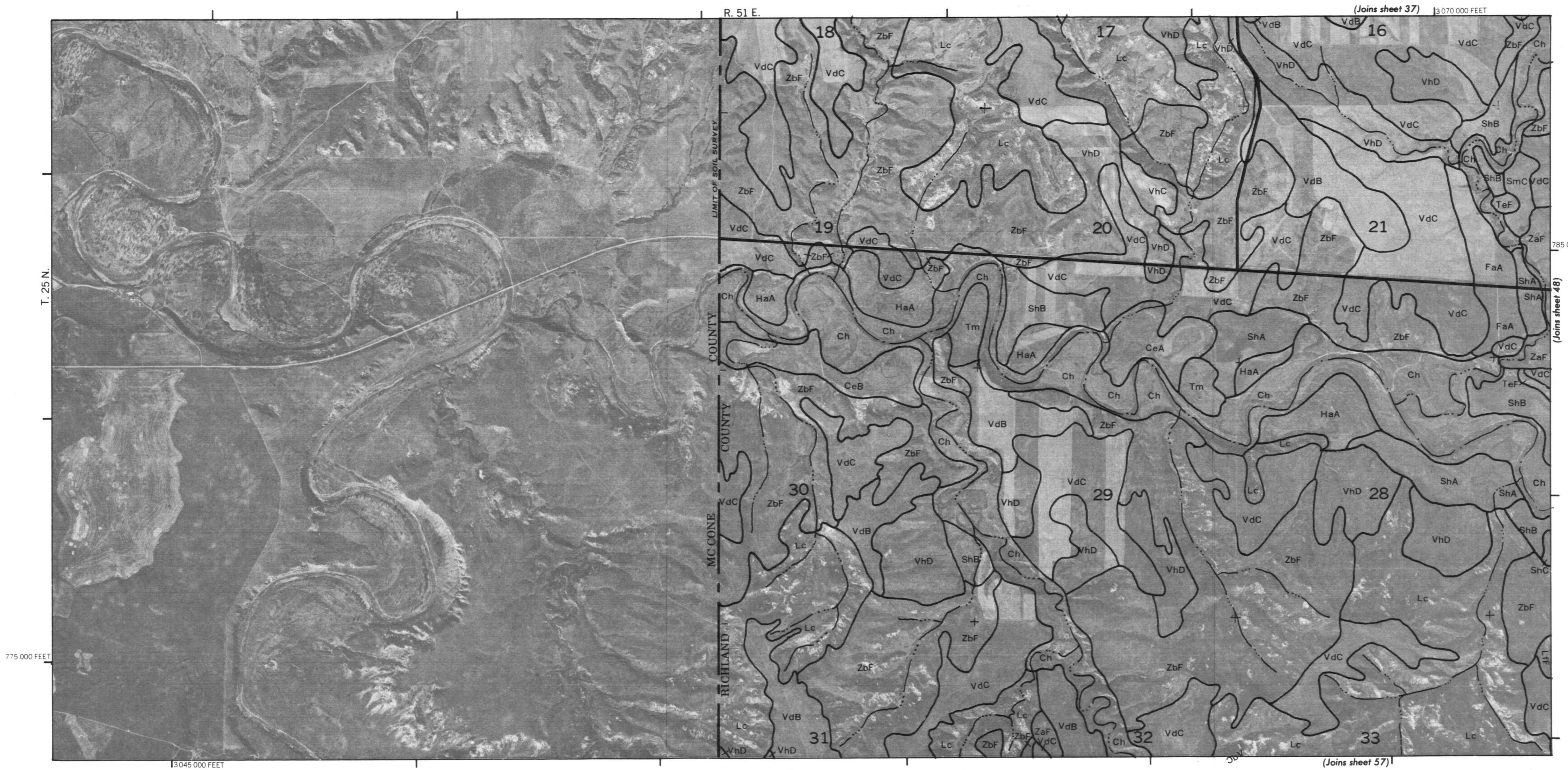
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

RICHLAND COUNTY, MONTANA NO. 46

RICHLAND COUNTY, MONTANA — SHEET NUMBER 47

N



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

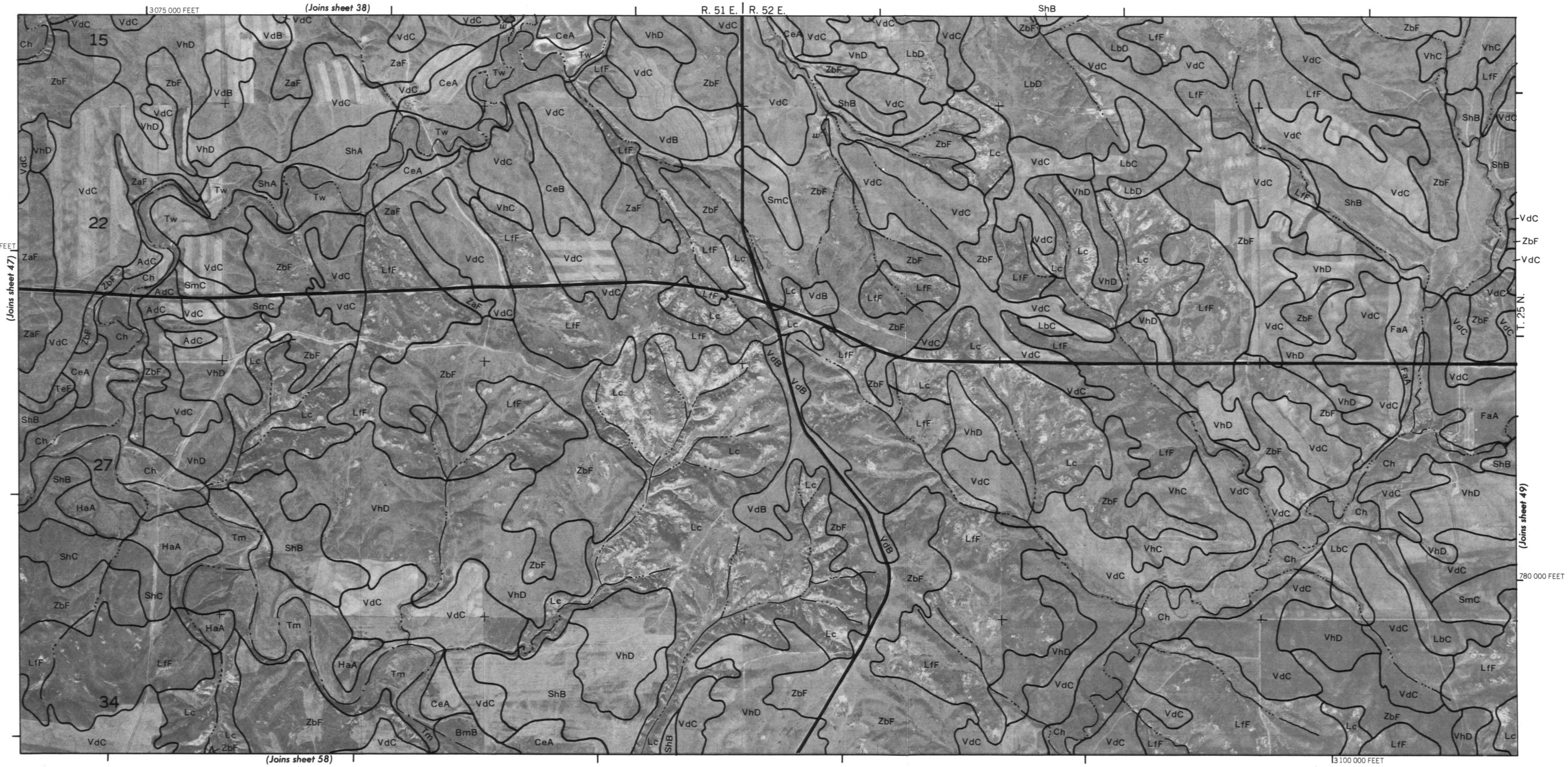
Scale 1:24 000

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

48

N

RICHLAND COUNTY, MONTANA — SHEET NUMBER 48



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 48

RICHLAND COUNTY, MONTANA — SHEET NUMBER 49

N

1 ¾ ½ ¼ 0 1 2 Miles

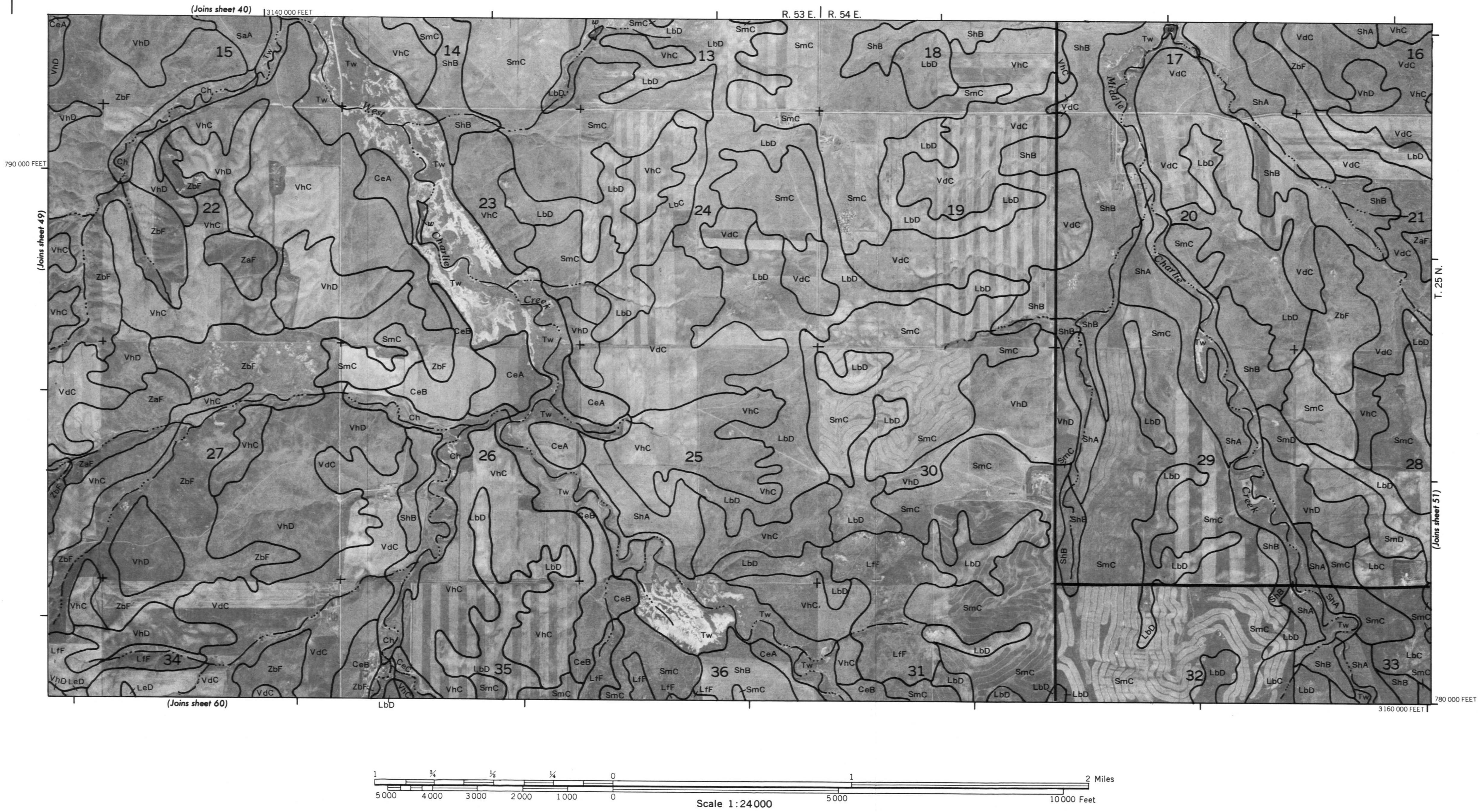
5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

RICHLAND COUNTY, MONTANA NO. 49

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

RICHLAND COUNTY, MONTANA — SHEET NUMBER 50



5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.
This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

N

RICHLAND COUNTY, MONTANA NO. 51

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

RICHLAND COUNTY, MONTANA — SHEET NUMBER 52

N

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

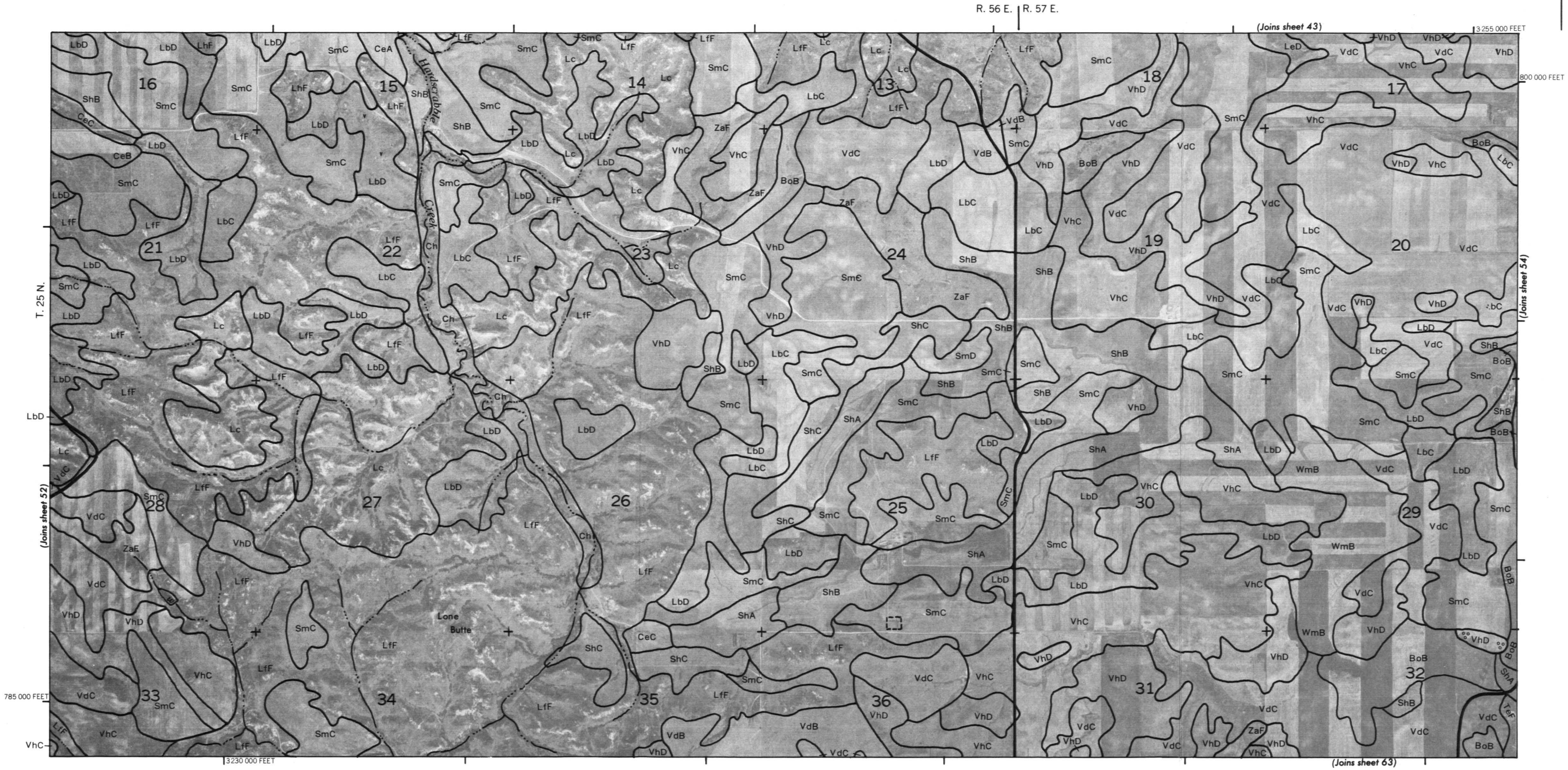
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

N

RICHLAND COUNTY, MONTANA NO. 53

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

RICHLAND COUNTY, MONTANA — SHEET NUMBER 54

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

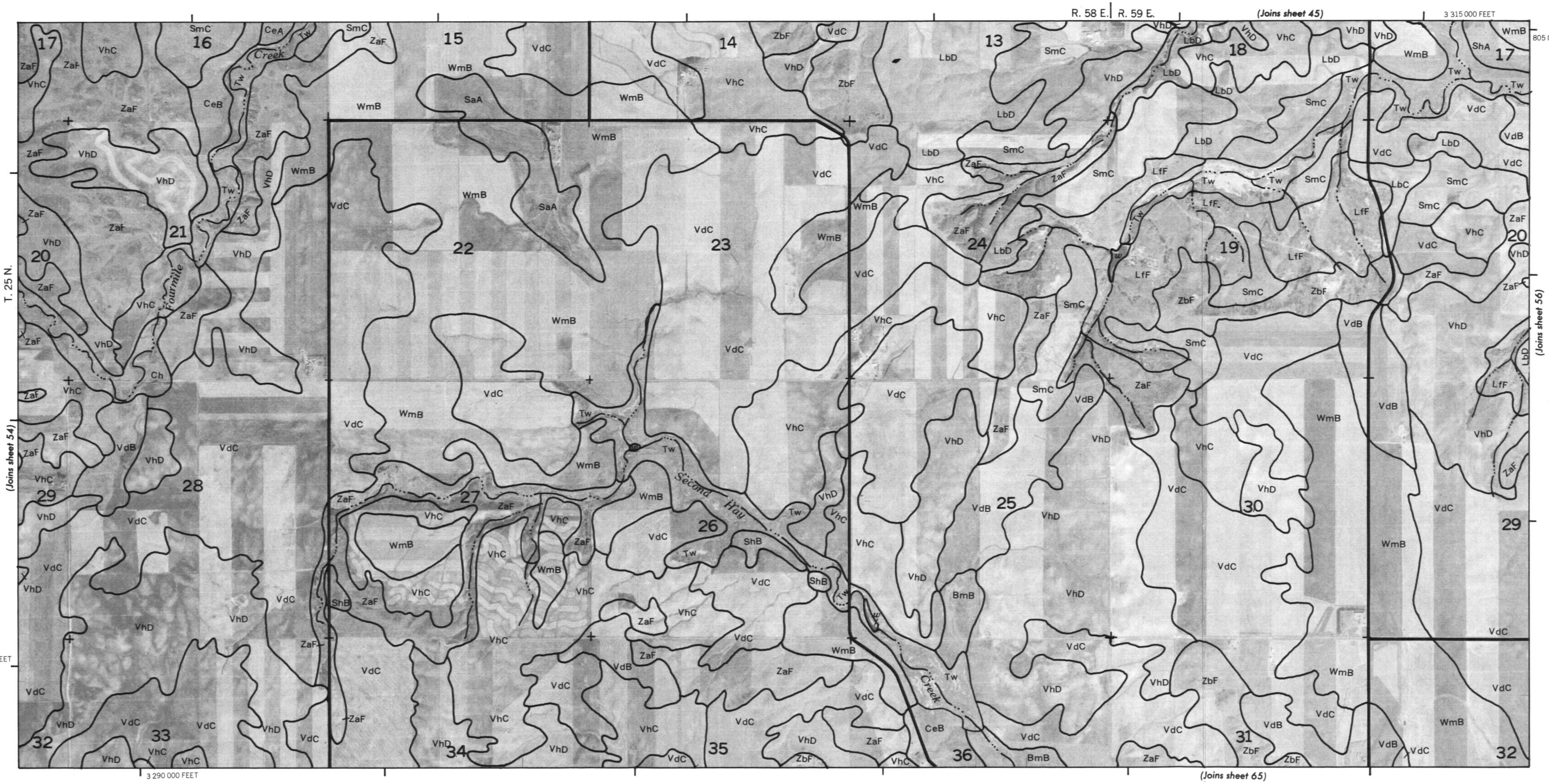
Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 54

N



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

RICHLAND COUNTY, MONTANA — SHEET NUMBER 56

N

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

57

N

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

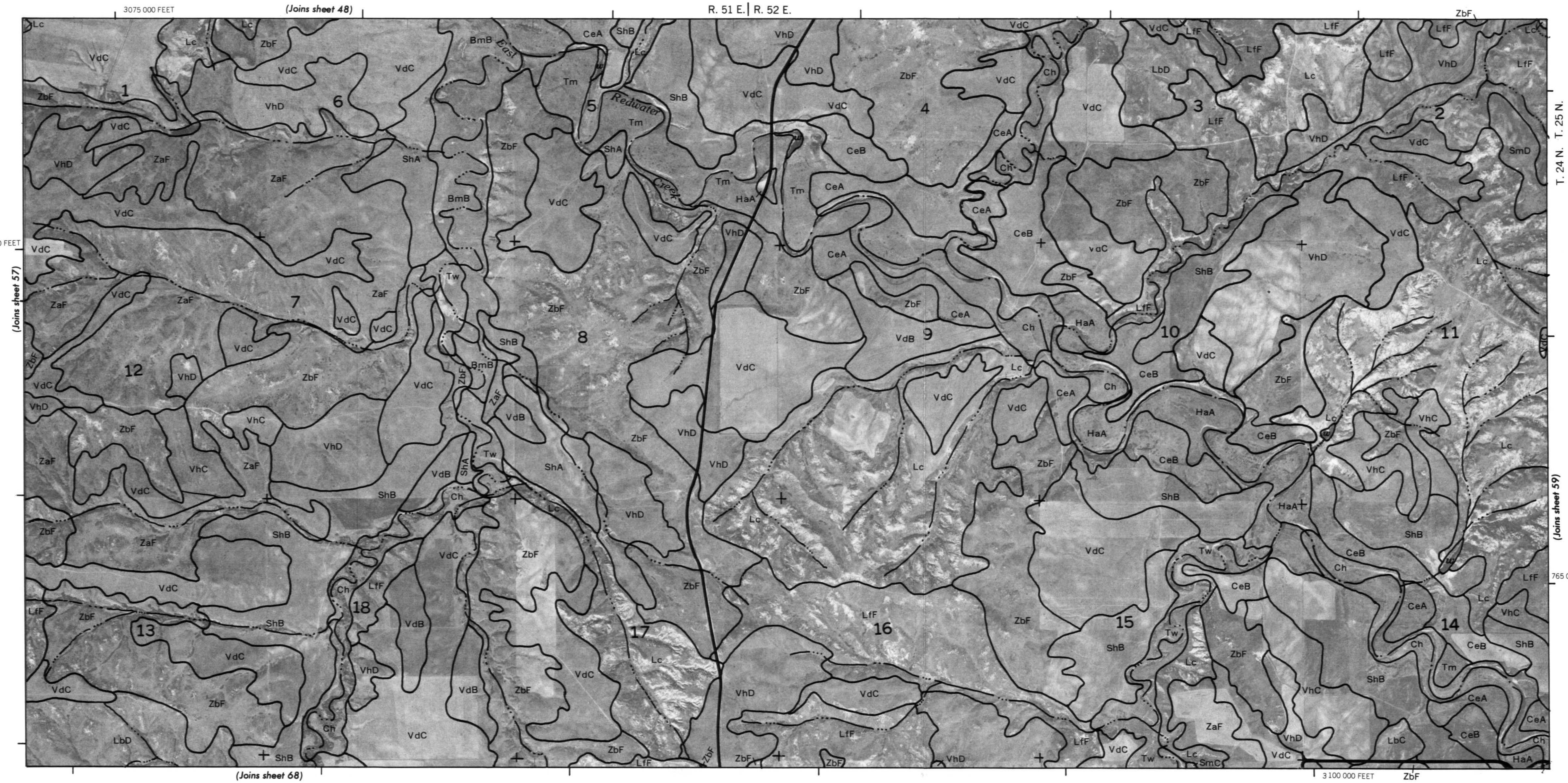
Scale 1:24000

RICHLAND COUNTY, MONTANA NO. 57

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

N

RICHLAND COUNTY, MONTANA — SHEET NUMBER 58



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

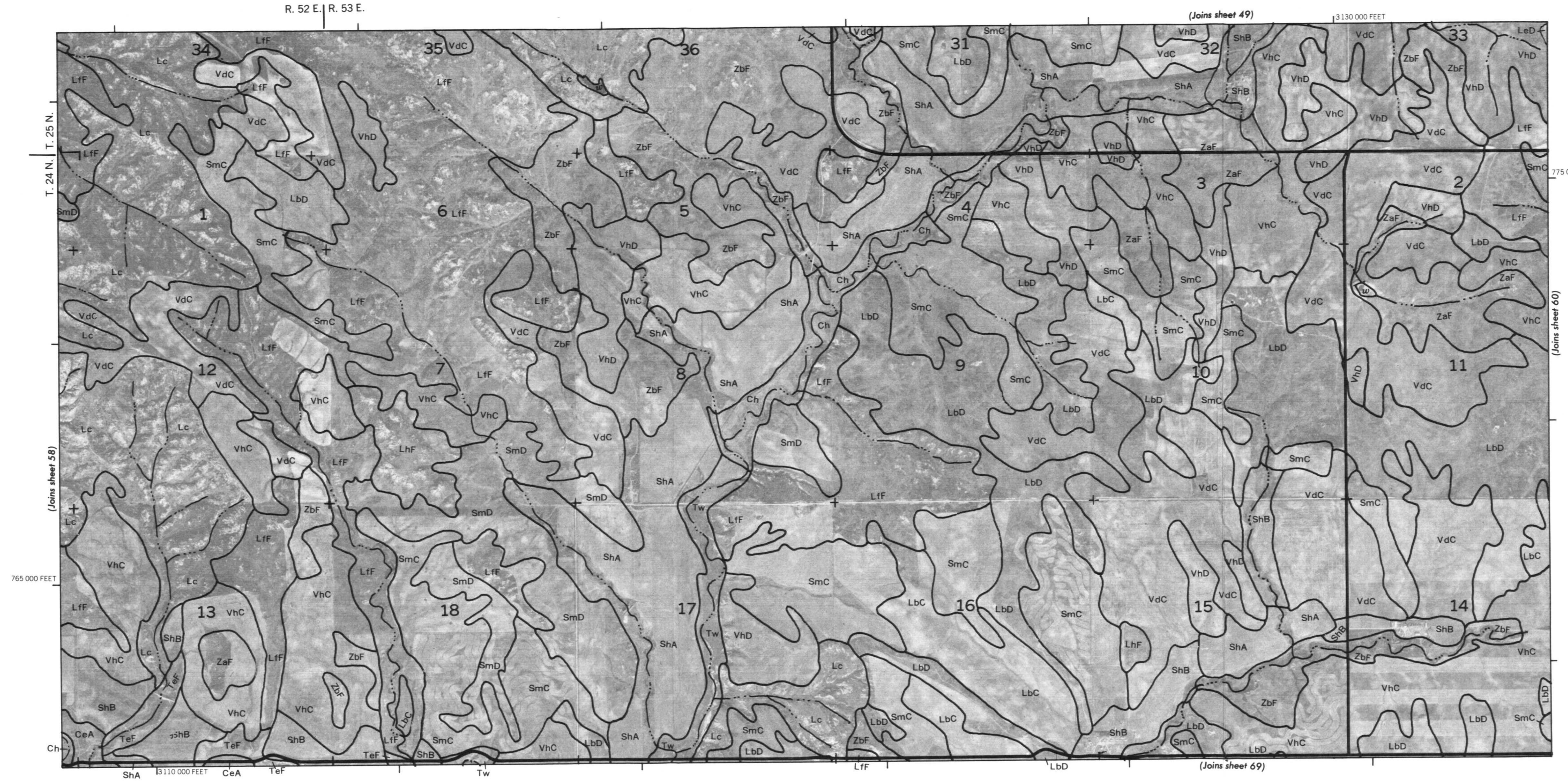
RICHLAND COUNTY, MONTANA NO. 58

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.
This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

N

RICHLAND COUNTY, MONTANA NO. 59

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



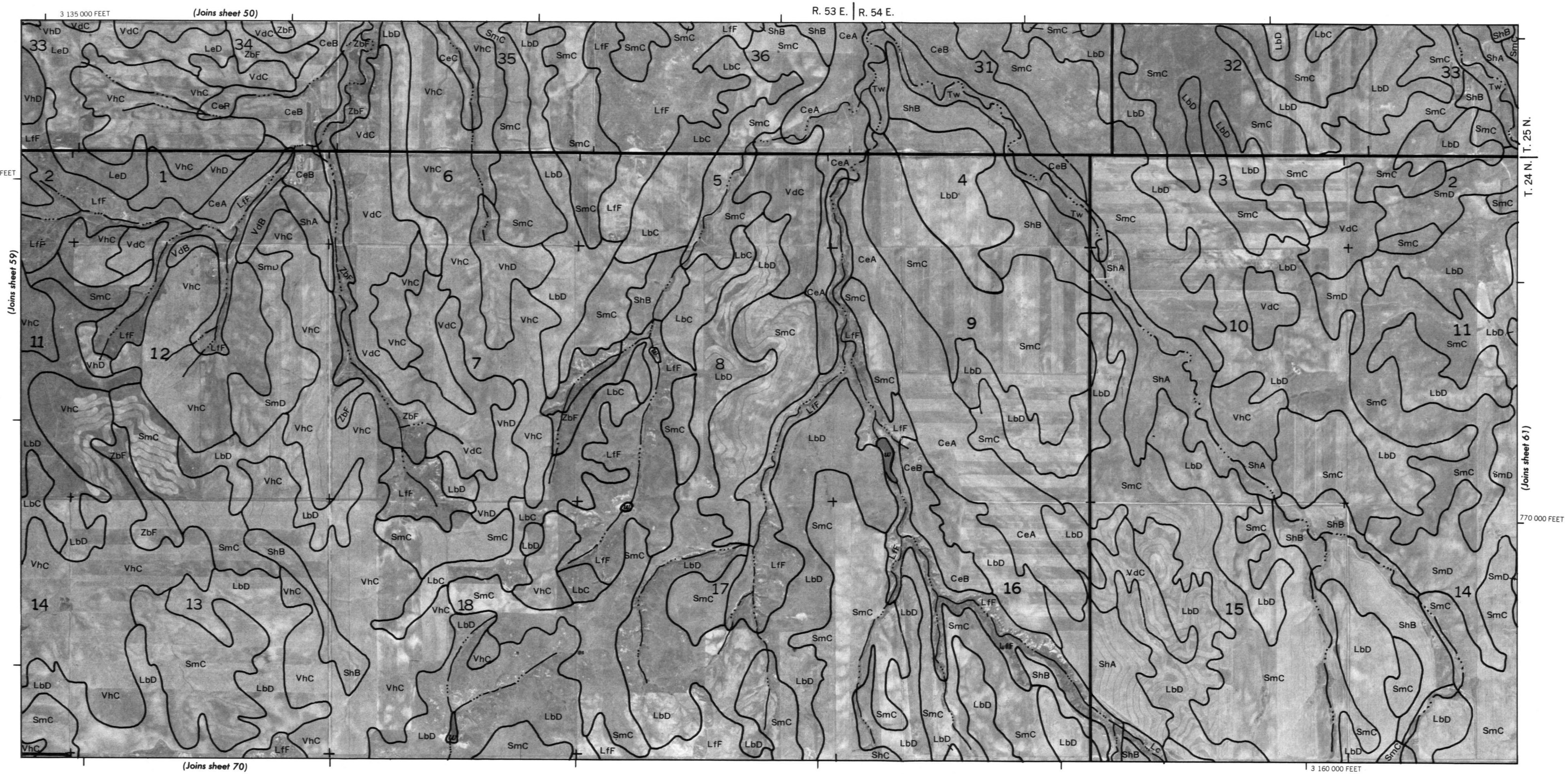
1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

Scale 1:24 000

N

RICHLAND COUNTY, MONTANA — SHEET NUMBER 60



1 ¾ ½ ¼ 0 1 2 Miles

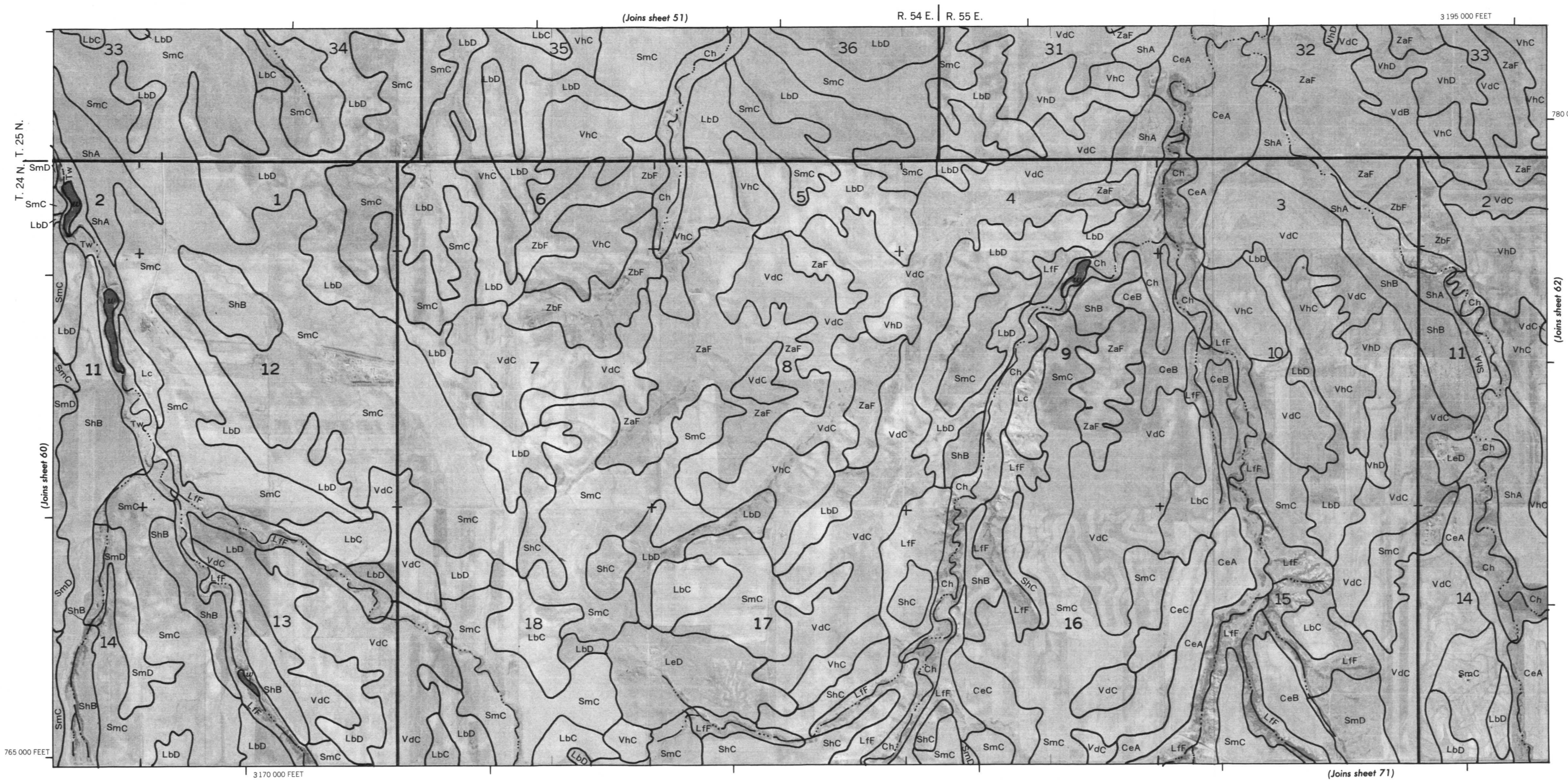
5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

N



1 ¾ ½ ¼ 0 1 2 Miles

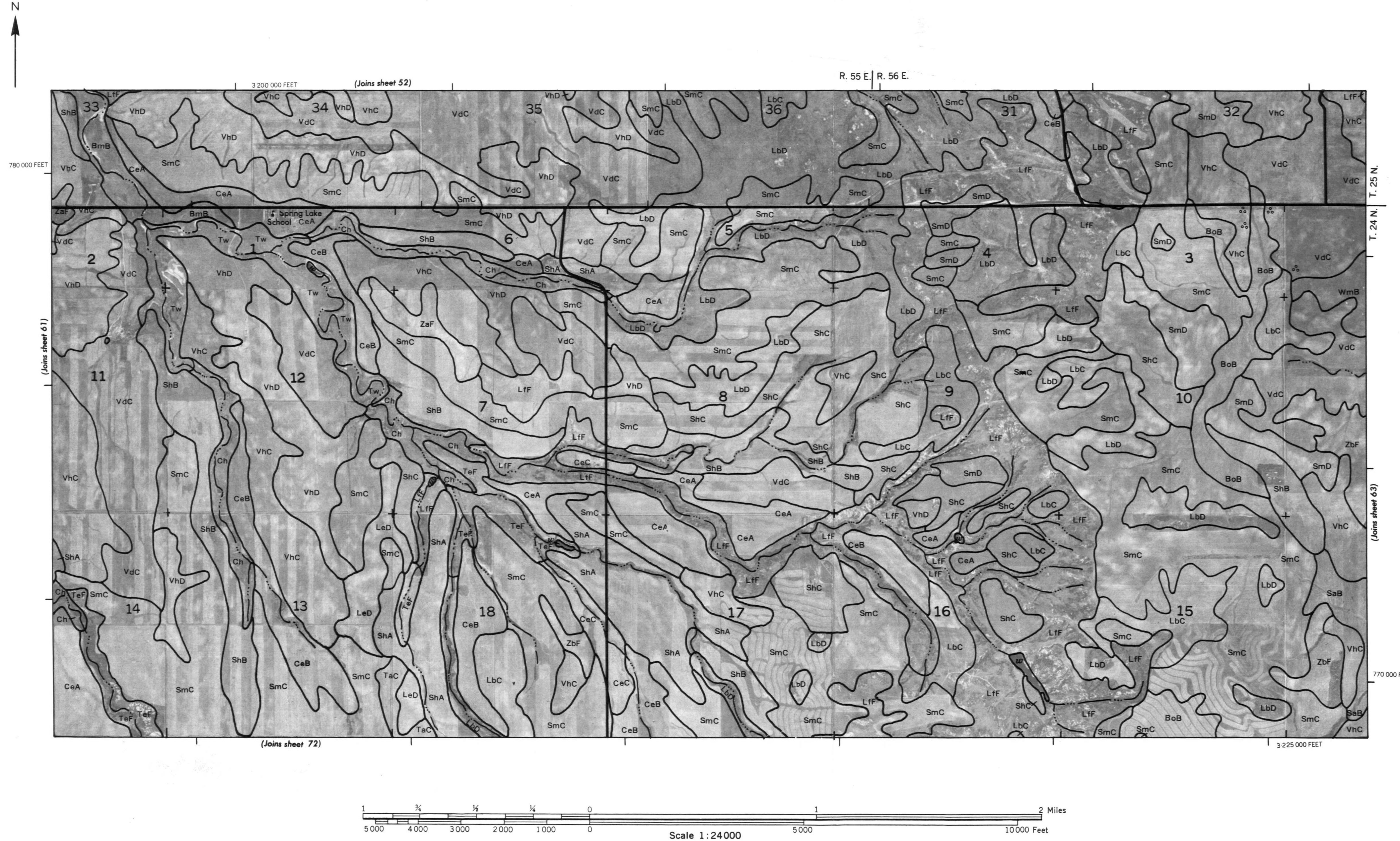
5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

RICHLAND COUNTY, MONTANA NO. 61

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

RICHLAND COUNTY, MONTANA — SHEET NUMBER 62

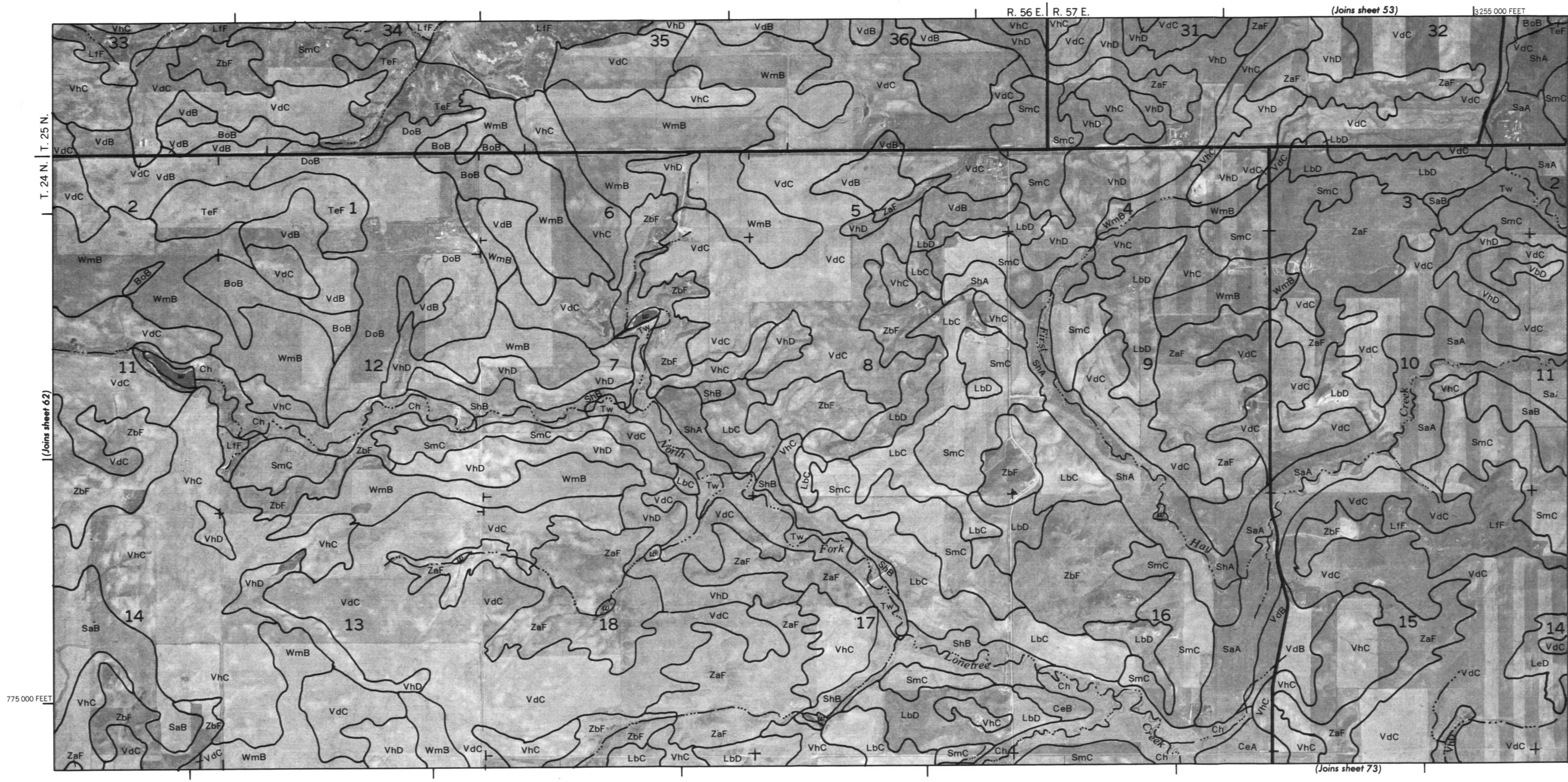


5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 62

N



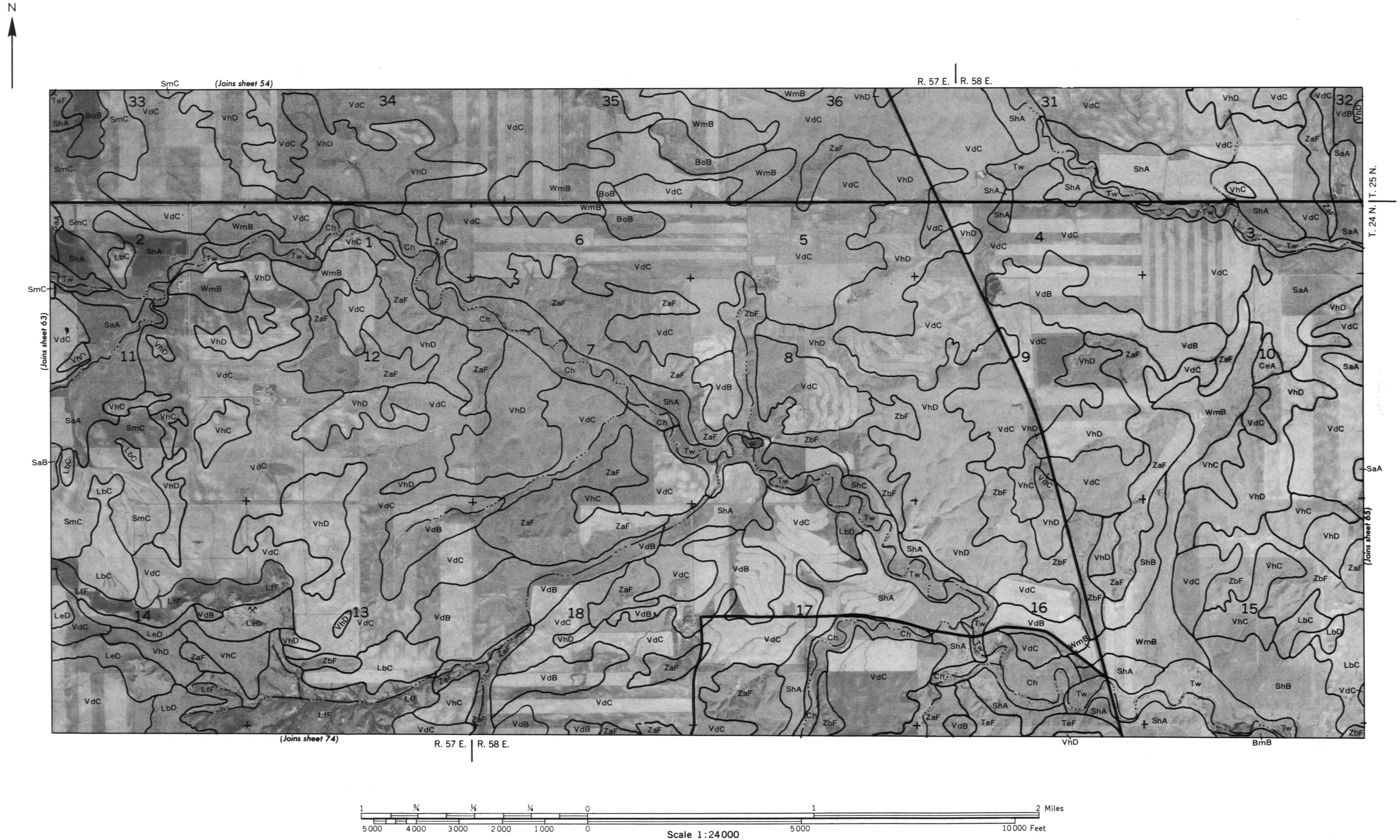
1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

Scale 1:24 000

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

RICHLAND COUNTY, MONTANA — SHEET NUMBER 64



5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ¾ ½ ¼ 0 1 2 Miles

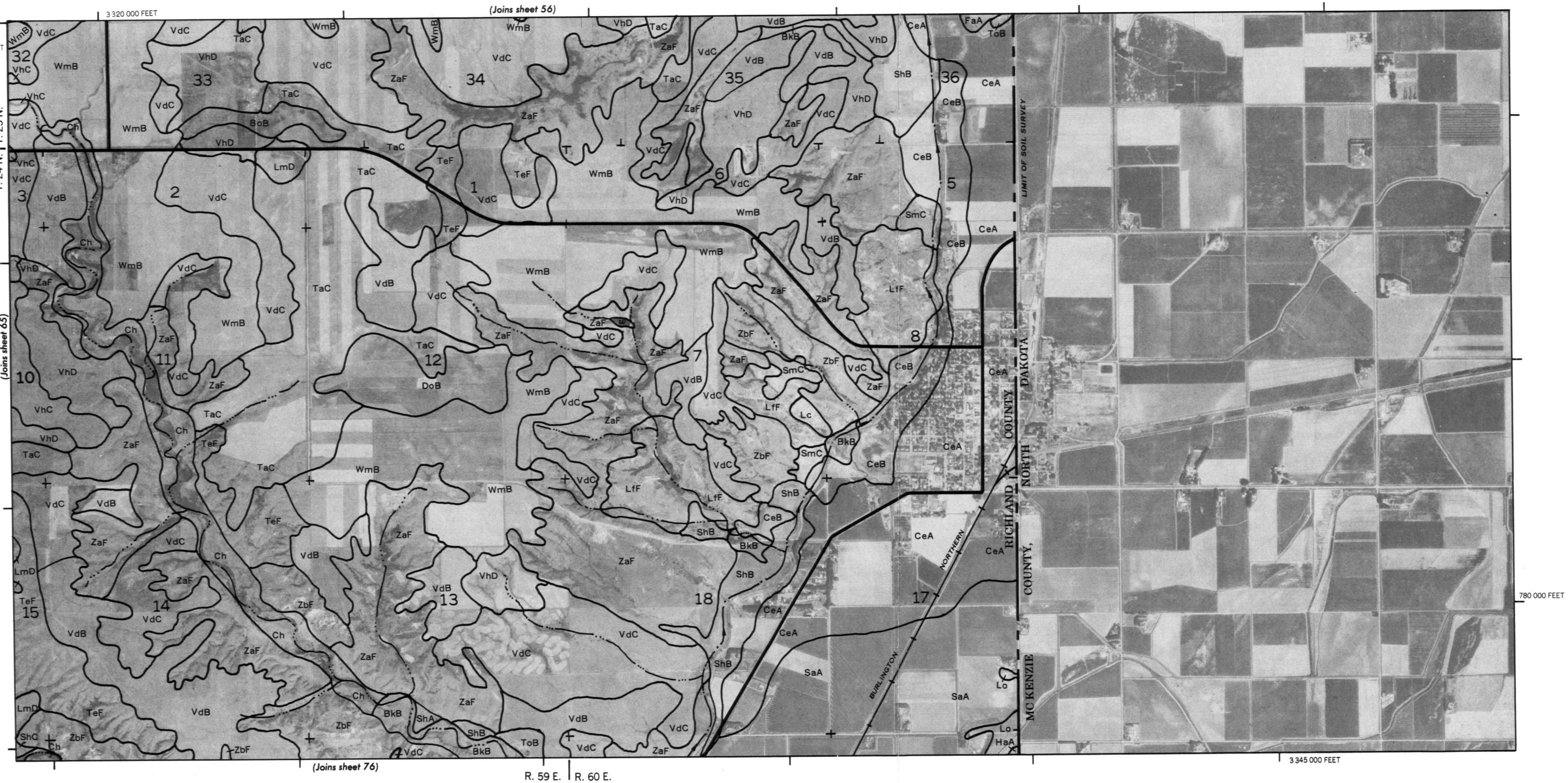
5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

RICHLAND COUNTY, MONTANA — SHEET NUMBER 66

N



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

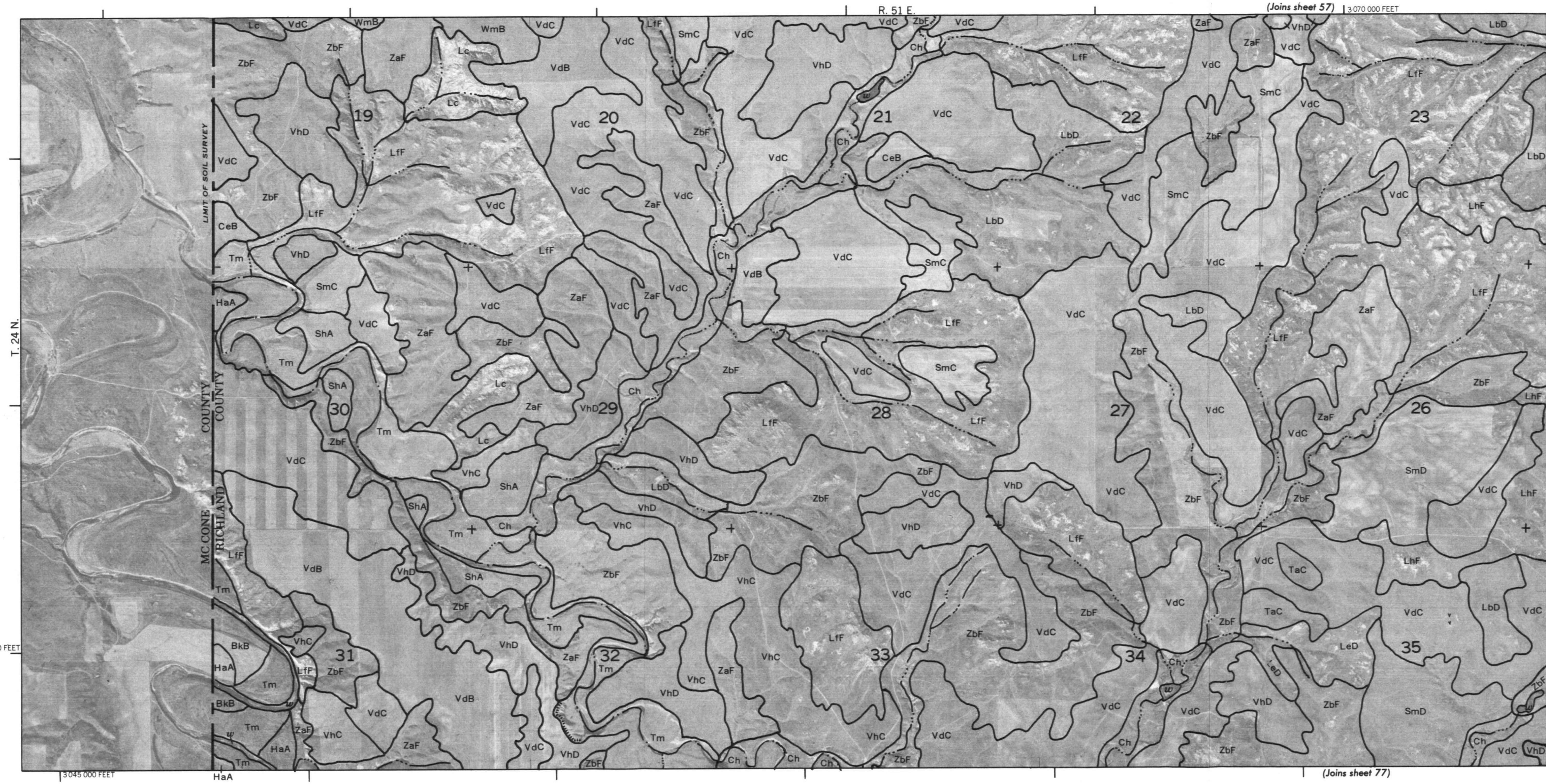
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 66

67

N



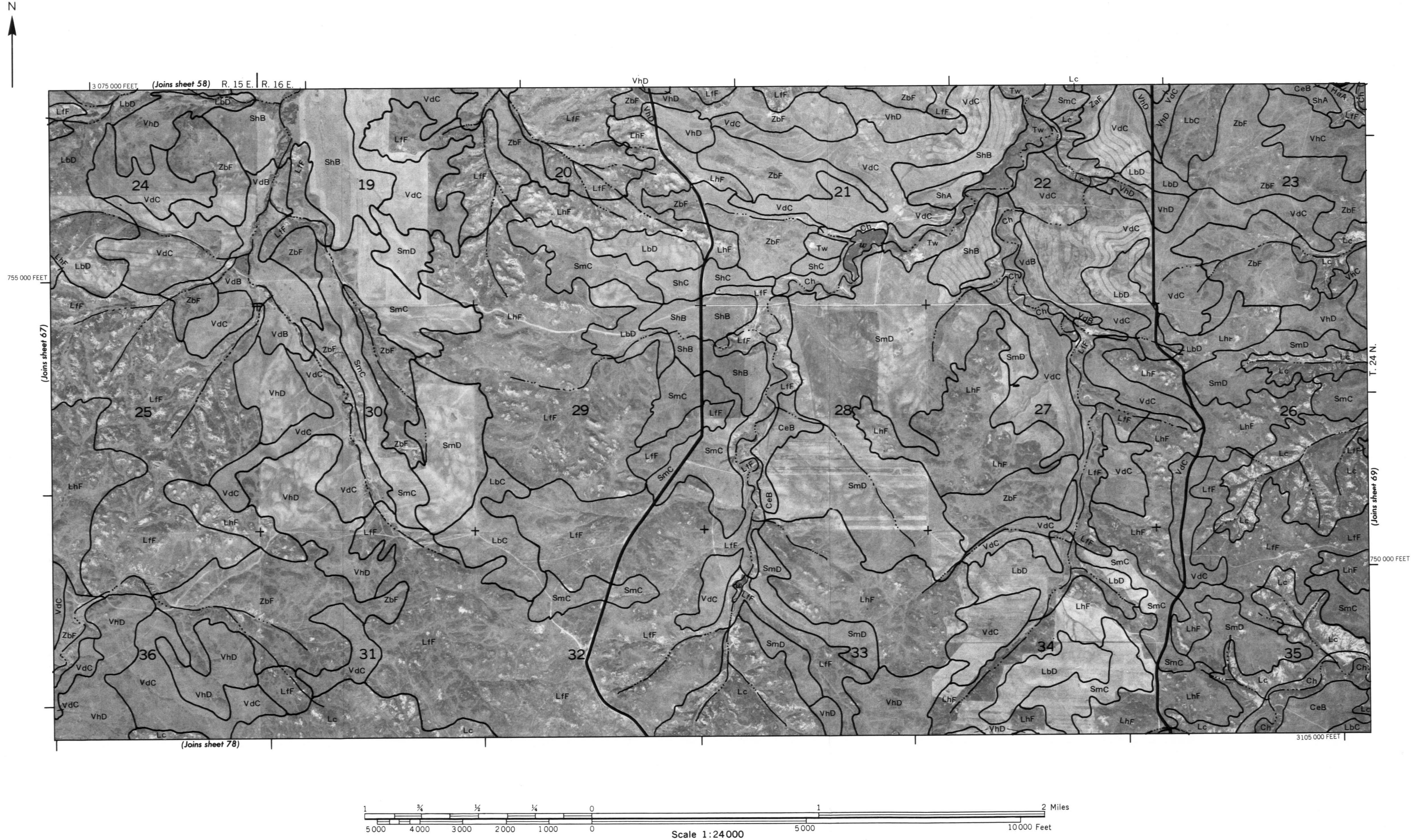
1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

Scale 1:24 000

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

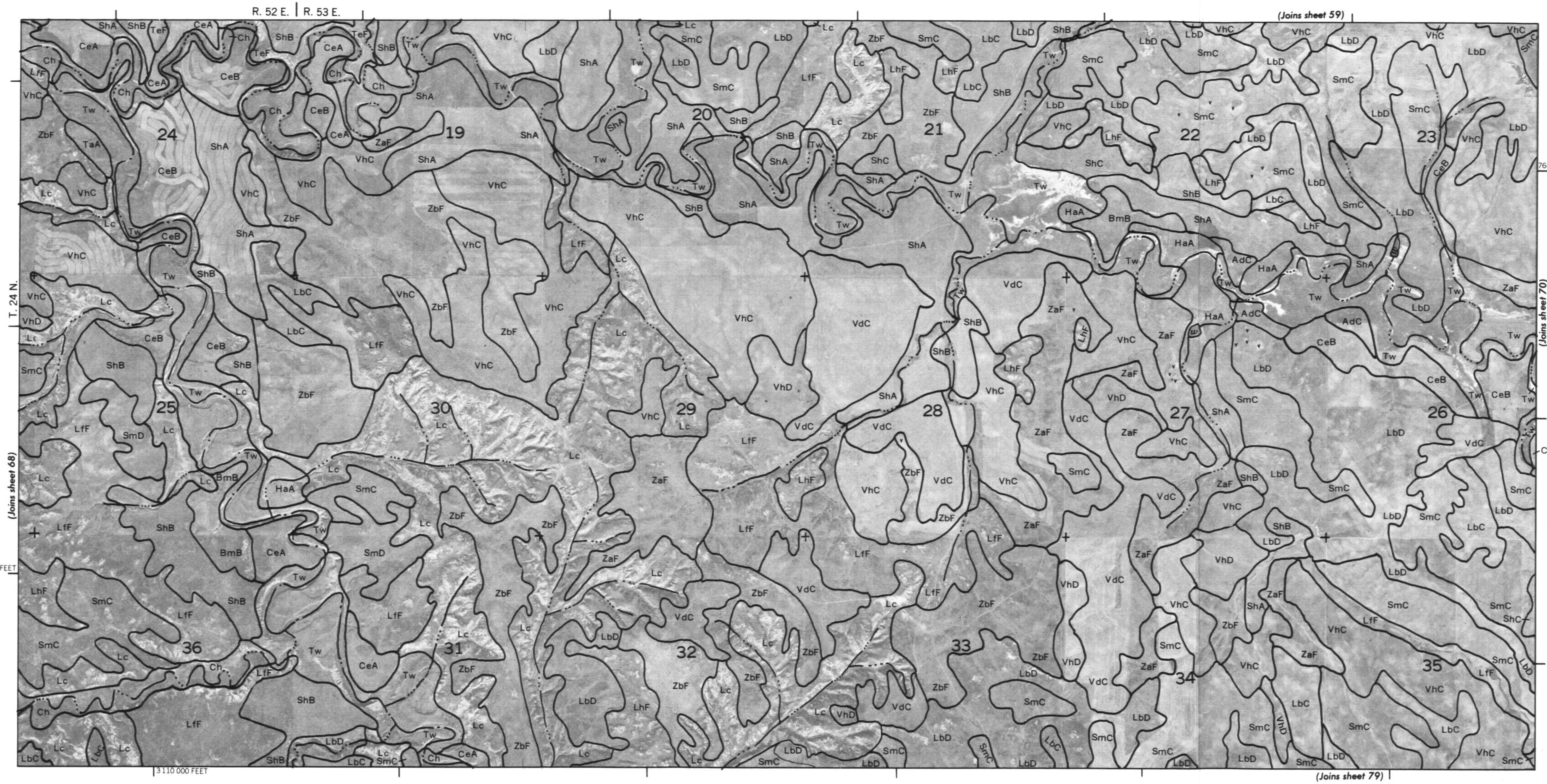
RICHLAND COUNTY, MONTANA — SHEET NUMBER 68



5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

N



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

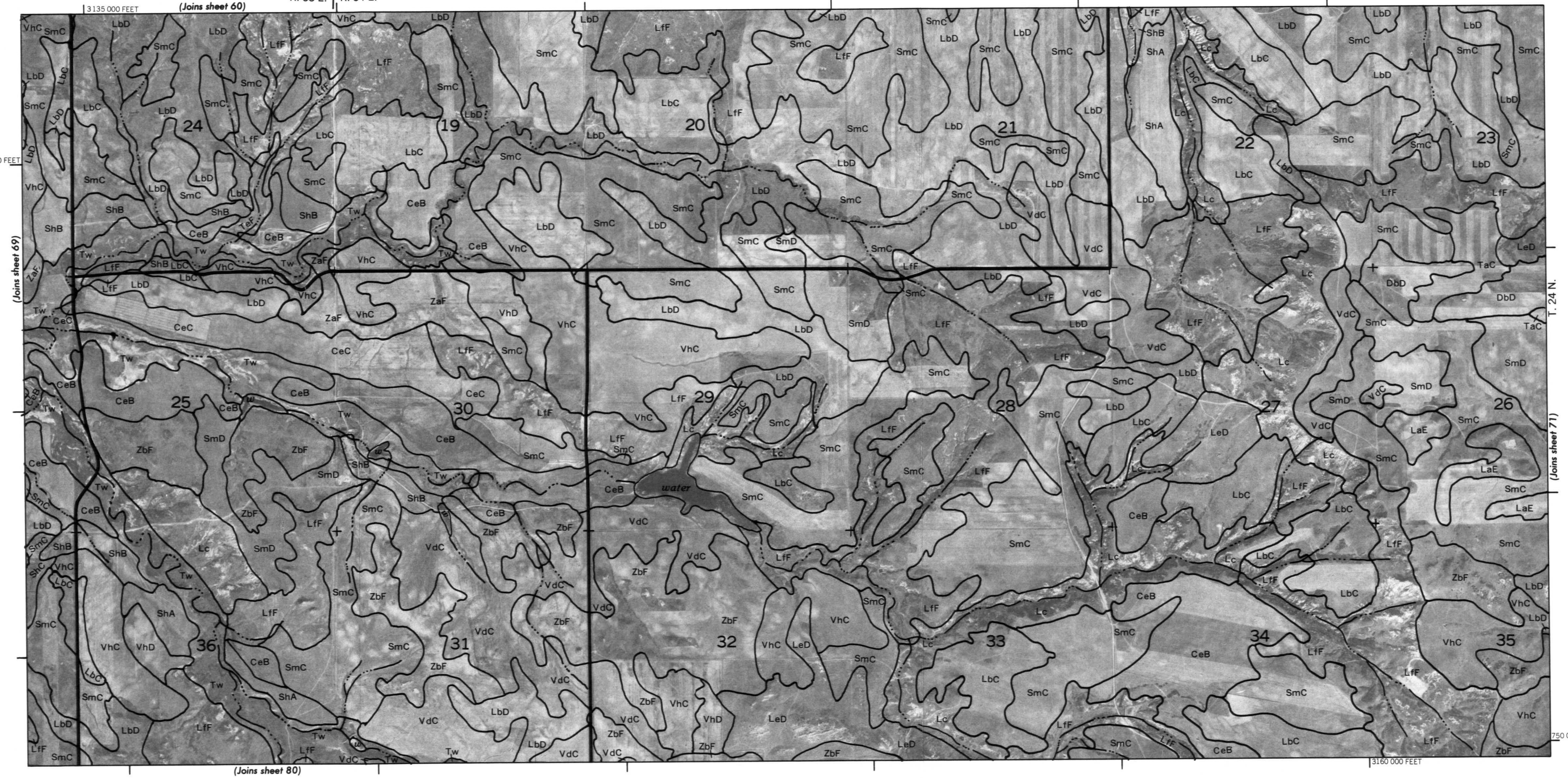
Scale 1:24 000

RICHLAND COUNTY, MONTANA NO. 69

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

RICHLAND COUNTY, MONTANA — SHEET NUMBER 70

N



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

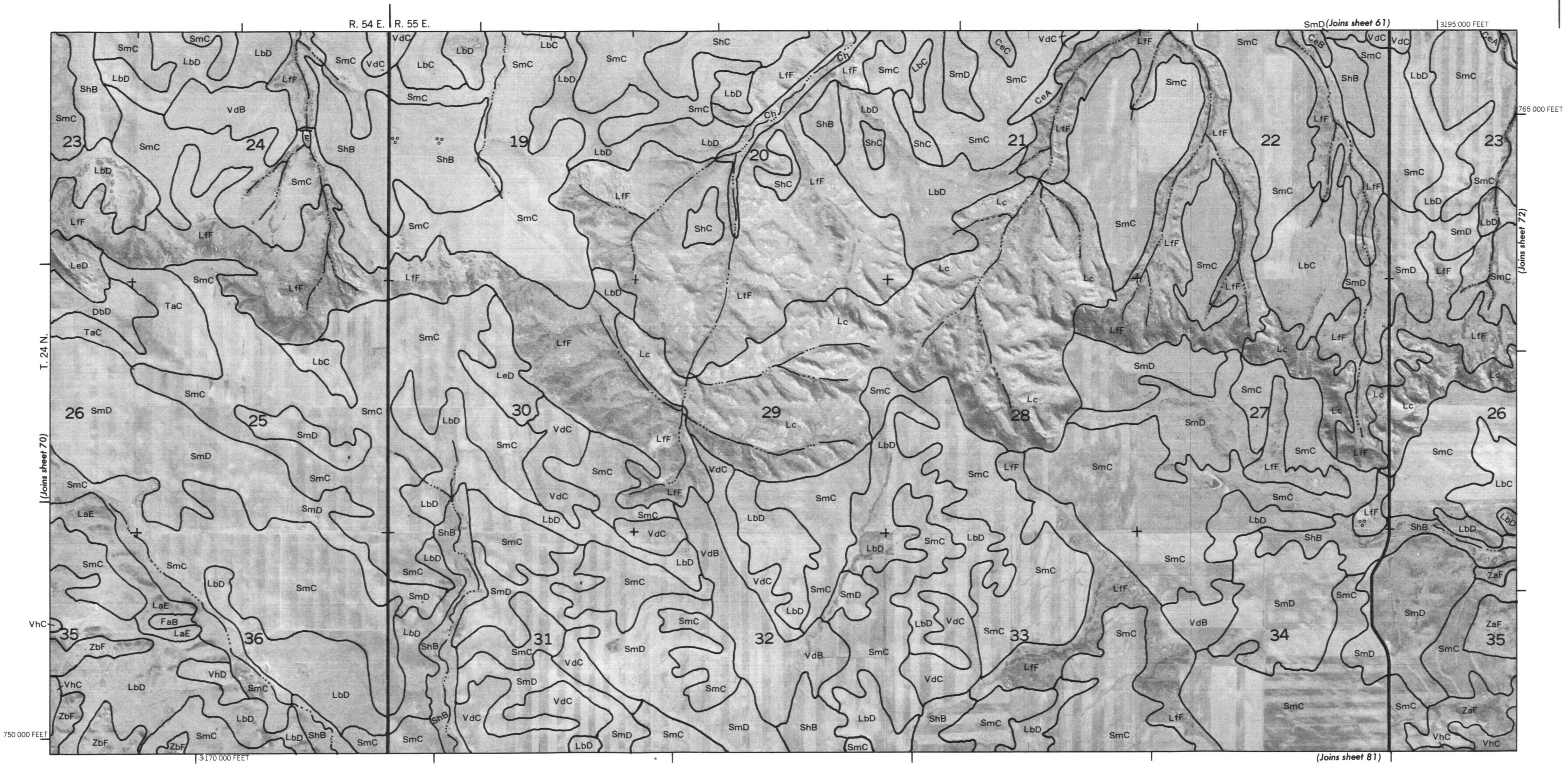
Scale 1:24 000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

71

N



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

RICHLAND COUNTY, MONTANA — SHEET NUMBER 72

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

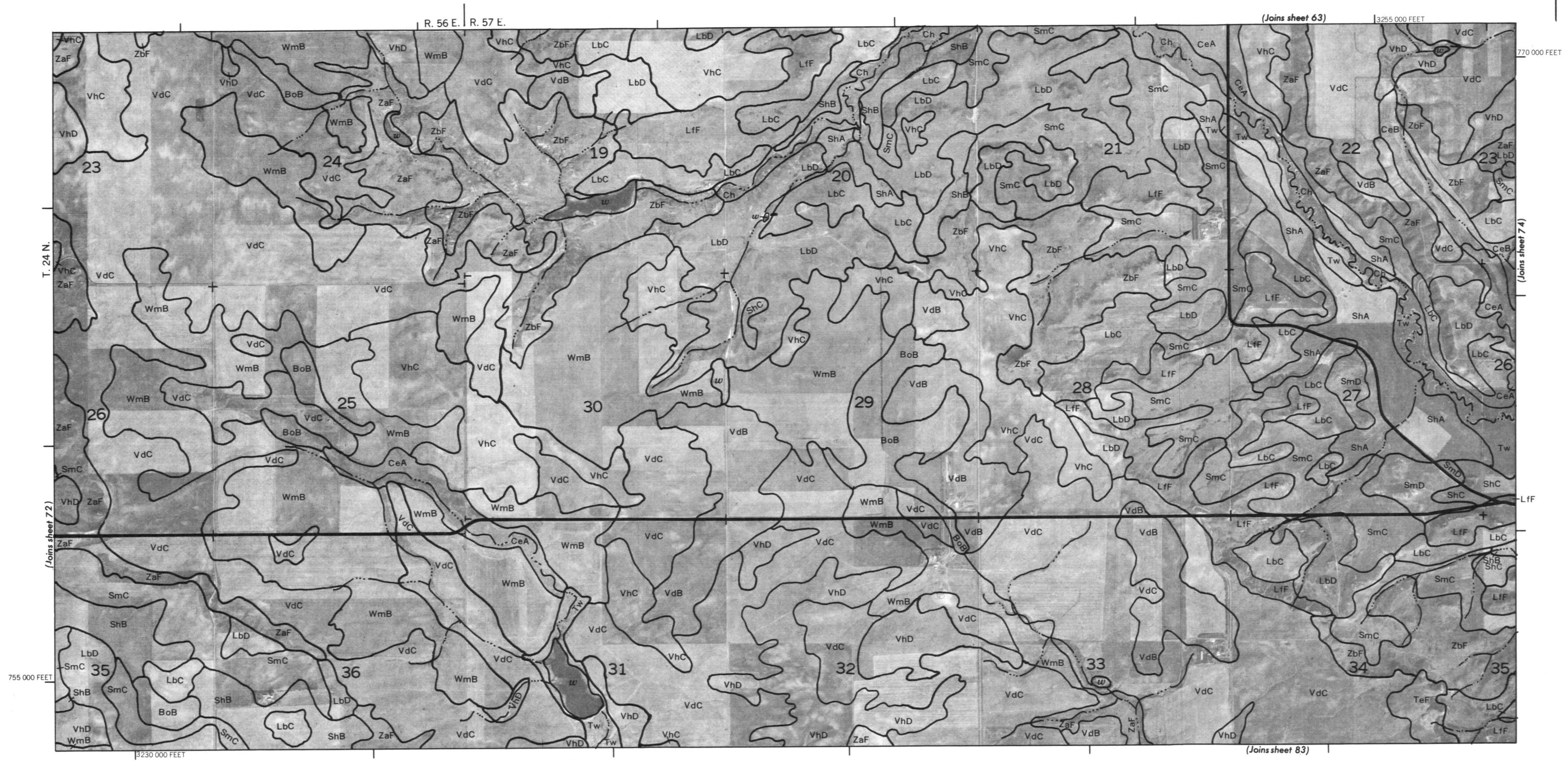
Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 72

RICHLAND COUNTY, MONTANA — SHEET NUMBER 73



This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

RICHLAND COUNTY, MONTANA — SHEET NUMBER 74

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

76

N

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

N

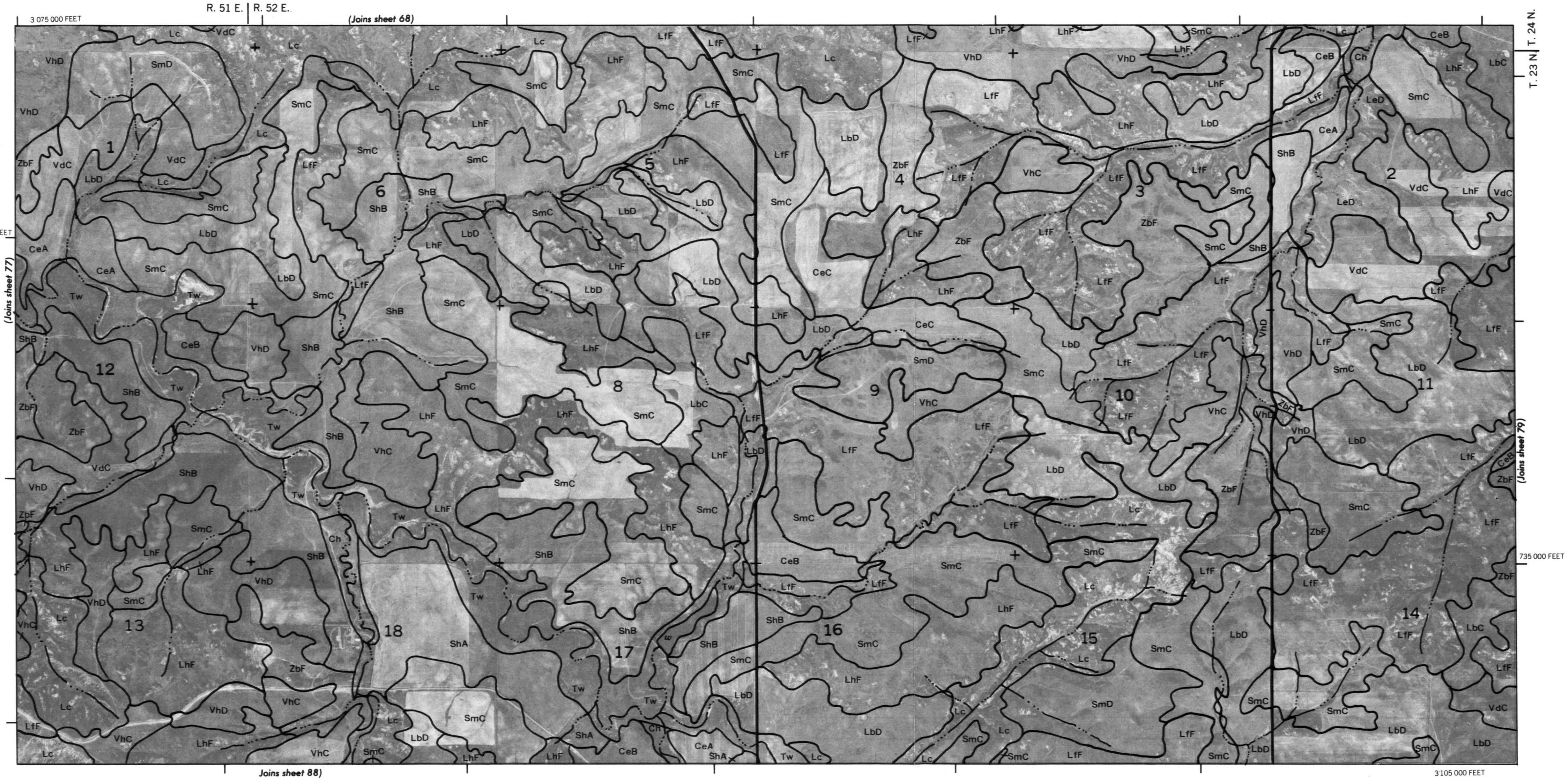
1 ¾ ½ ¼ 0 1 2 Miles
5000 4000 3000 2000 1000 0 5000 10000 Feet
Scale 1:24000

RICHLAND COUNTY, MONTANA NO. 77

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

N

RICHLAND COUNTY, MONTANA — SHEET NUMBER 78



1 ¾ ½ ¼ 0 1 2 Miles

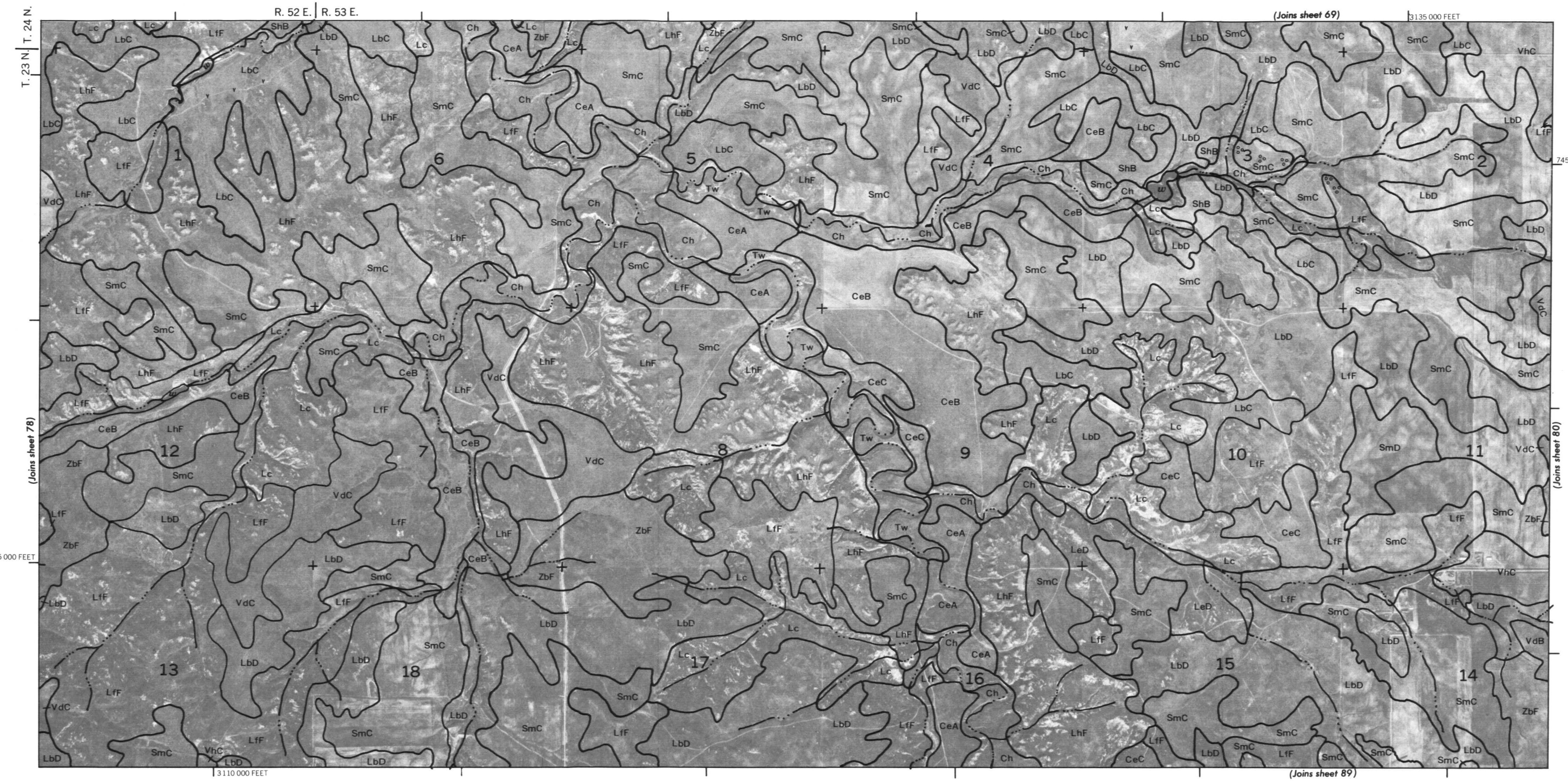
5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

79

N



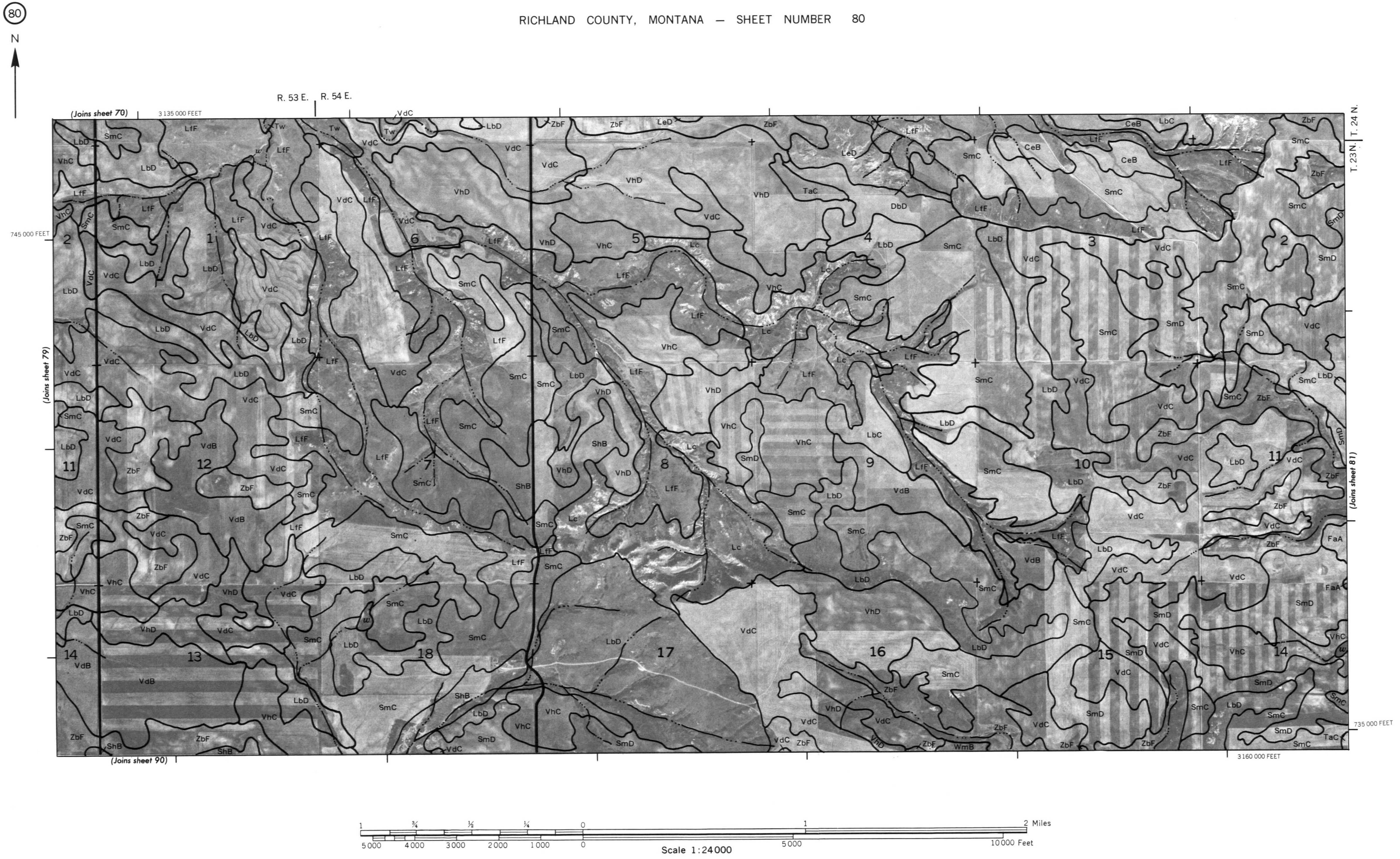
RICHLAND COUNTY, MONTANA NO. 79

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000



5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

N

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

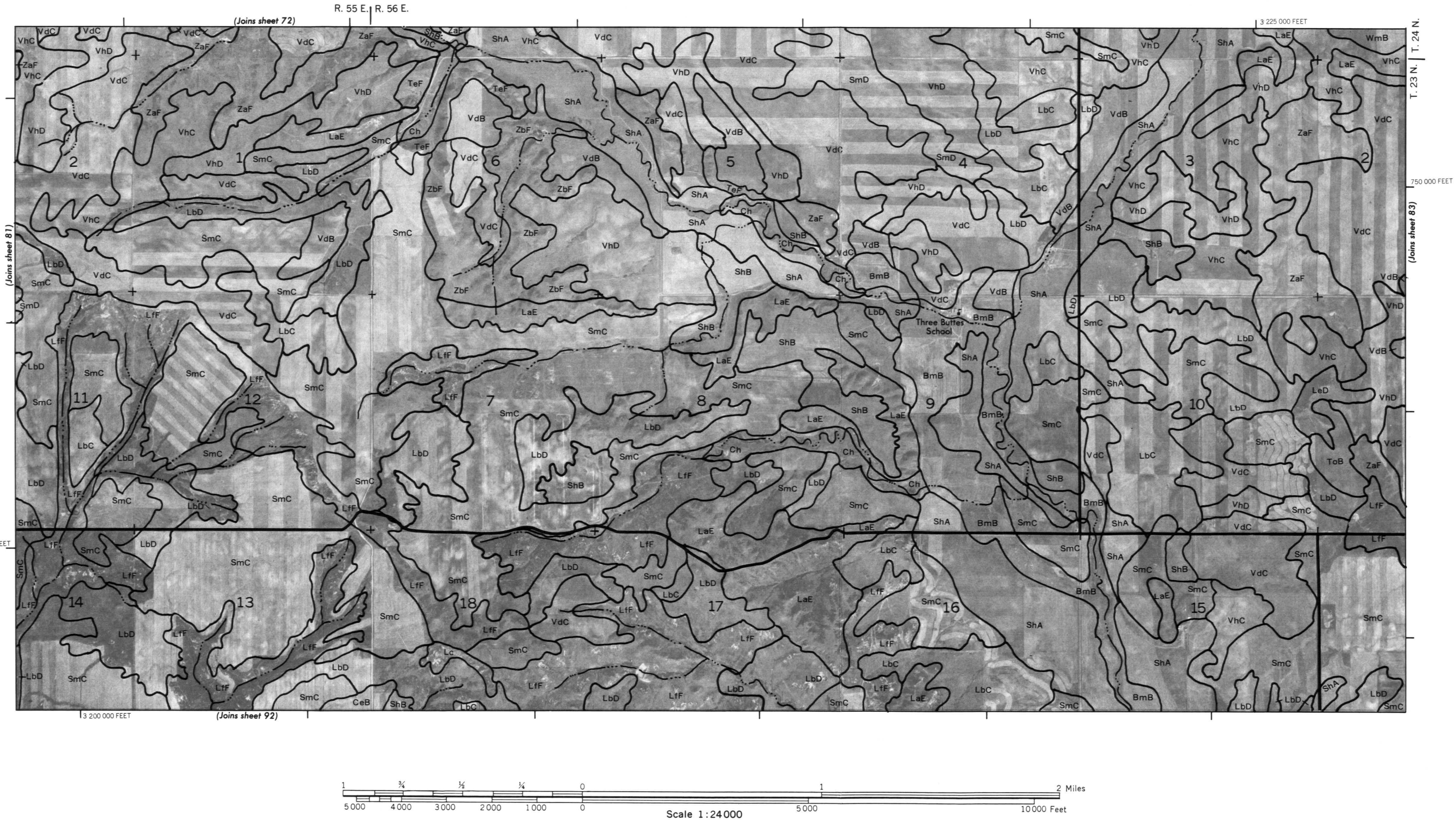
Scale 1:24000

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

82

N

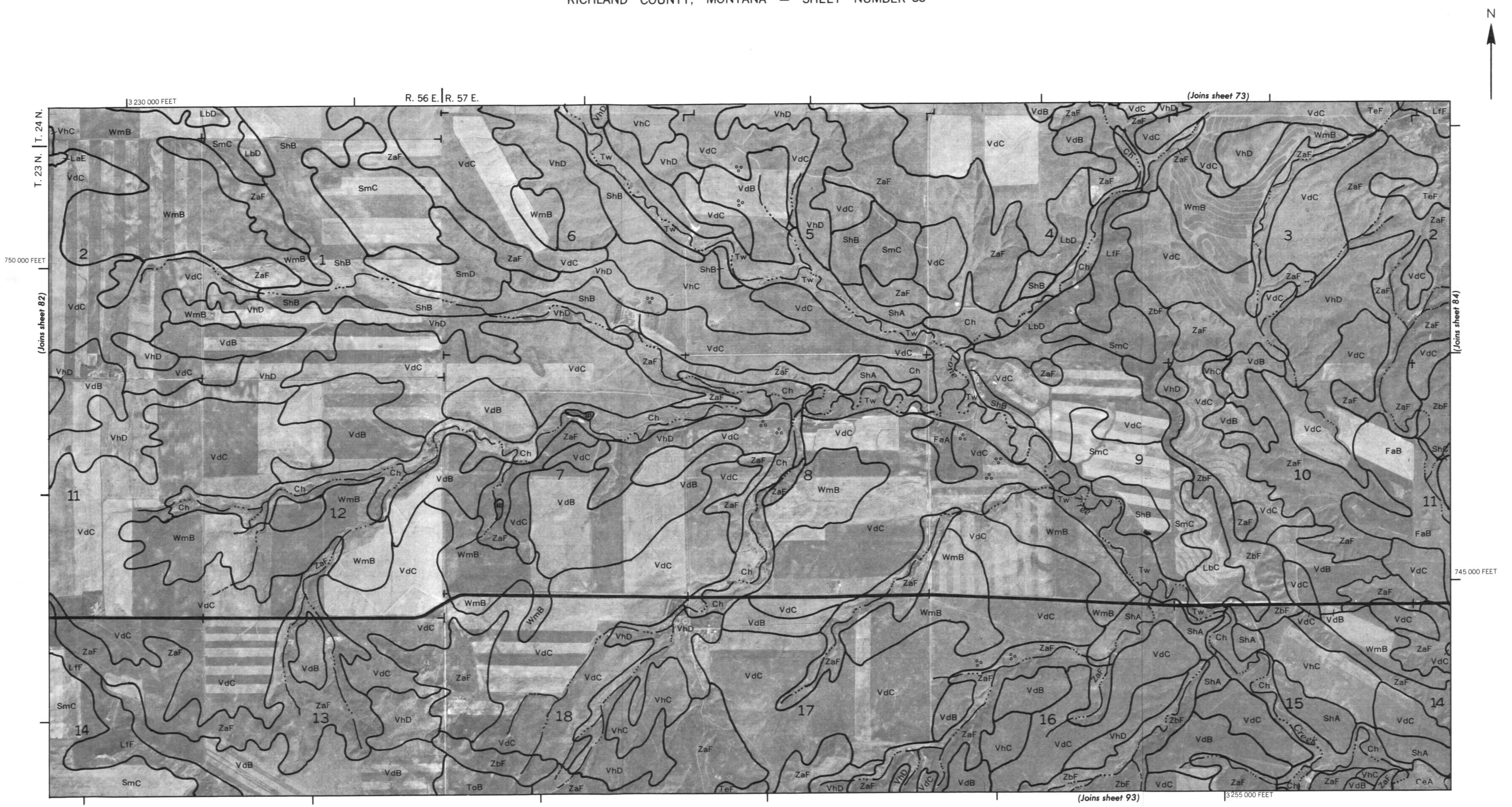
RICHLAND COUNTY, MONTANA — SHEET NUMBER 82



5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 82



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

RICHLAND COUNTY, MONTANA — SHEET NUMBER 84

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

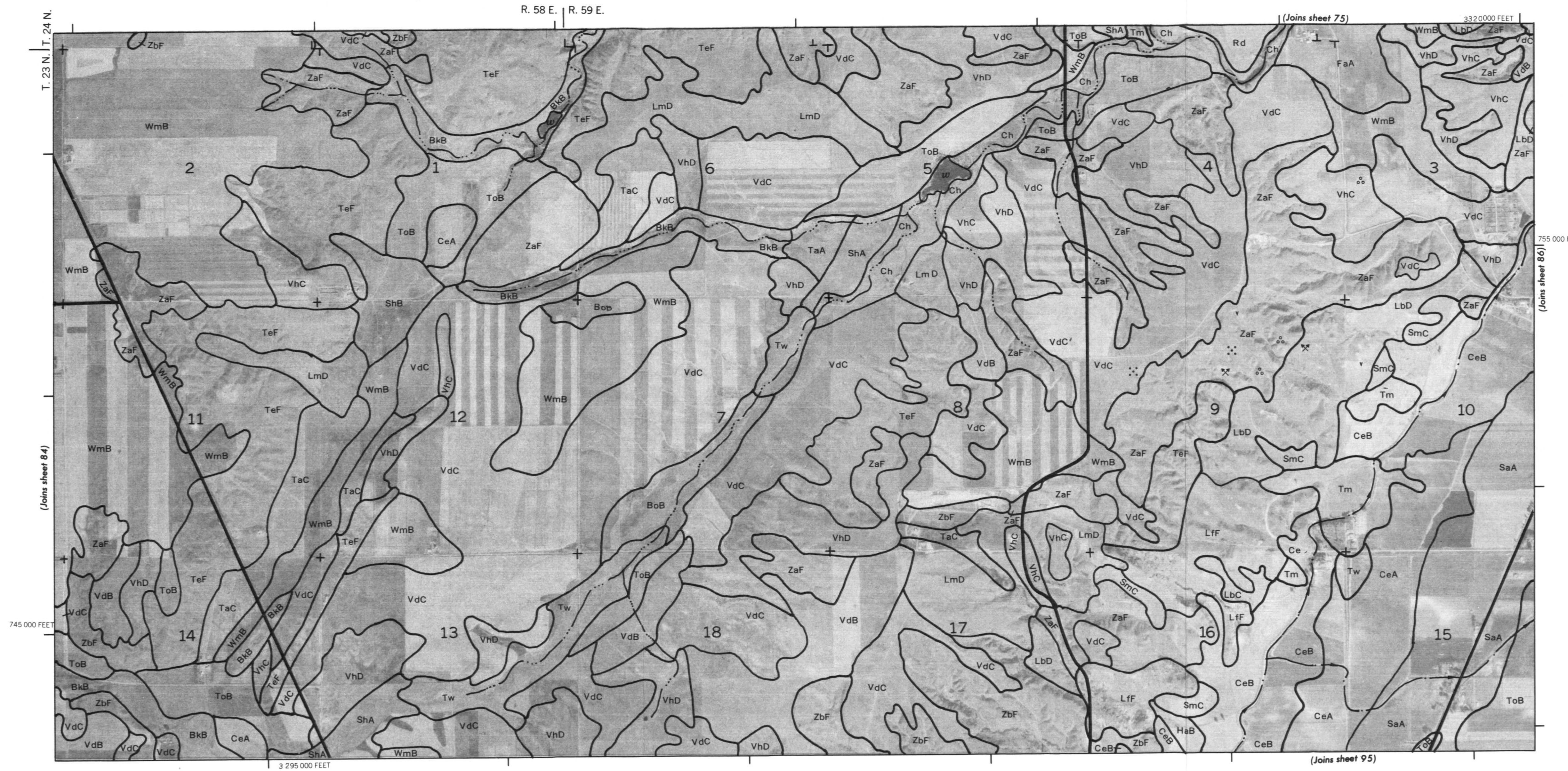
Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 84

85



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

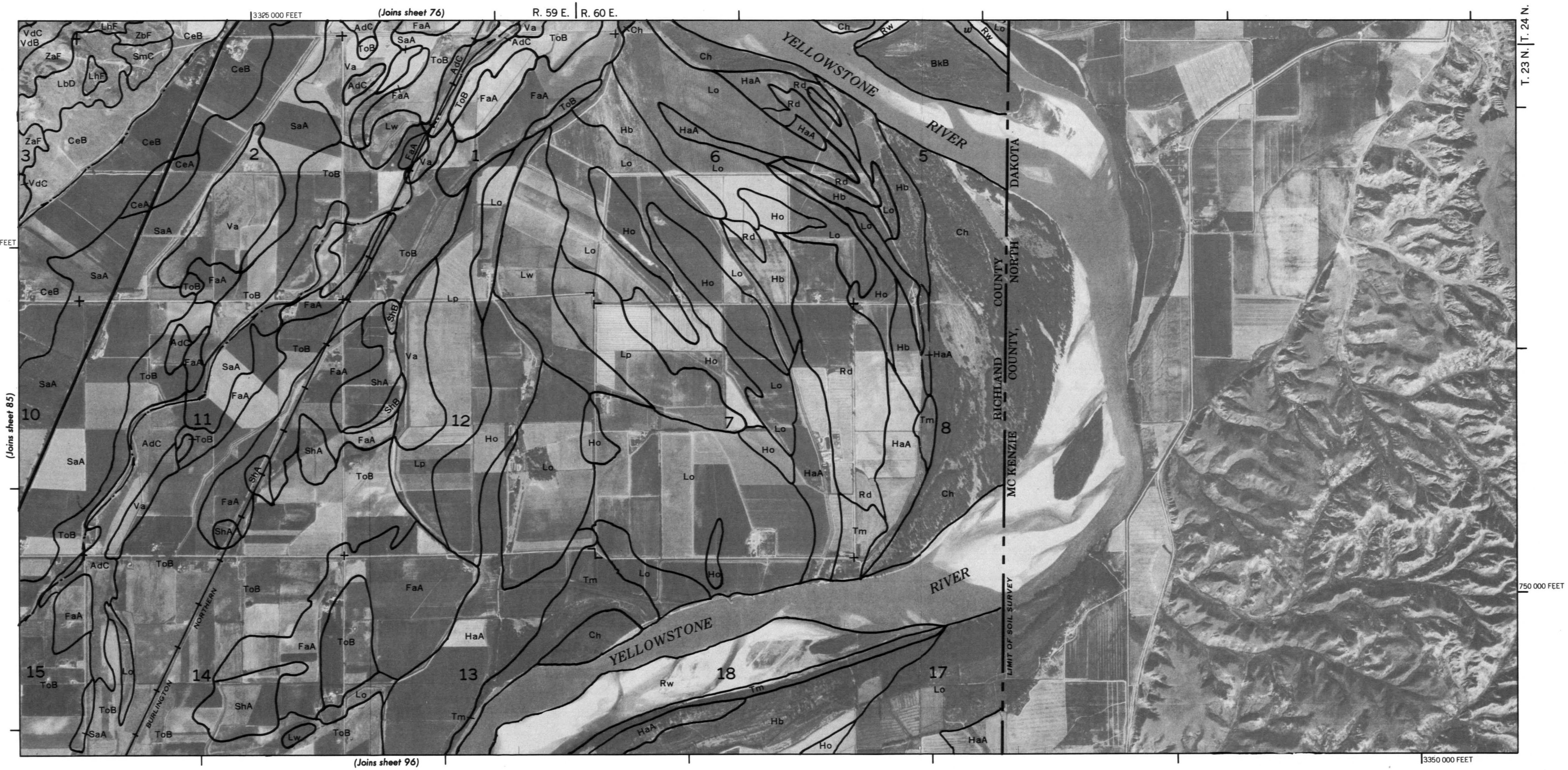
Scale 1:24000

RICHLAND COUNTY, MONTANA NO. 85

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

N

RICHLAND COUNTY, MONTANA — SHEET NUMBER 86



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

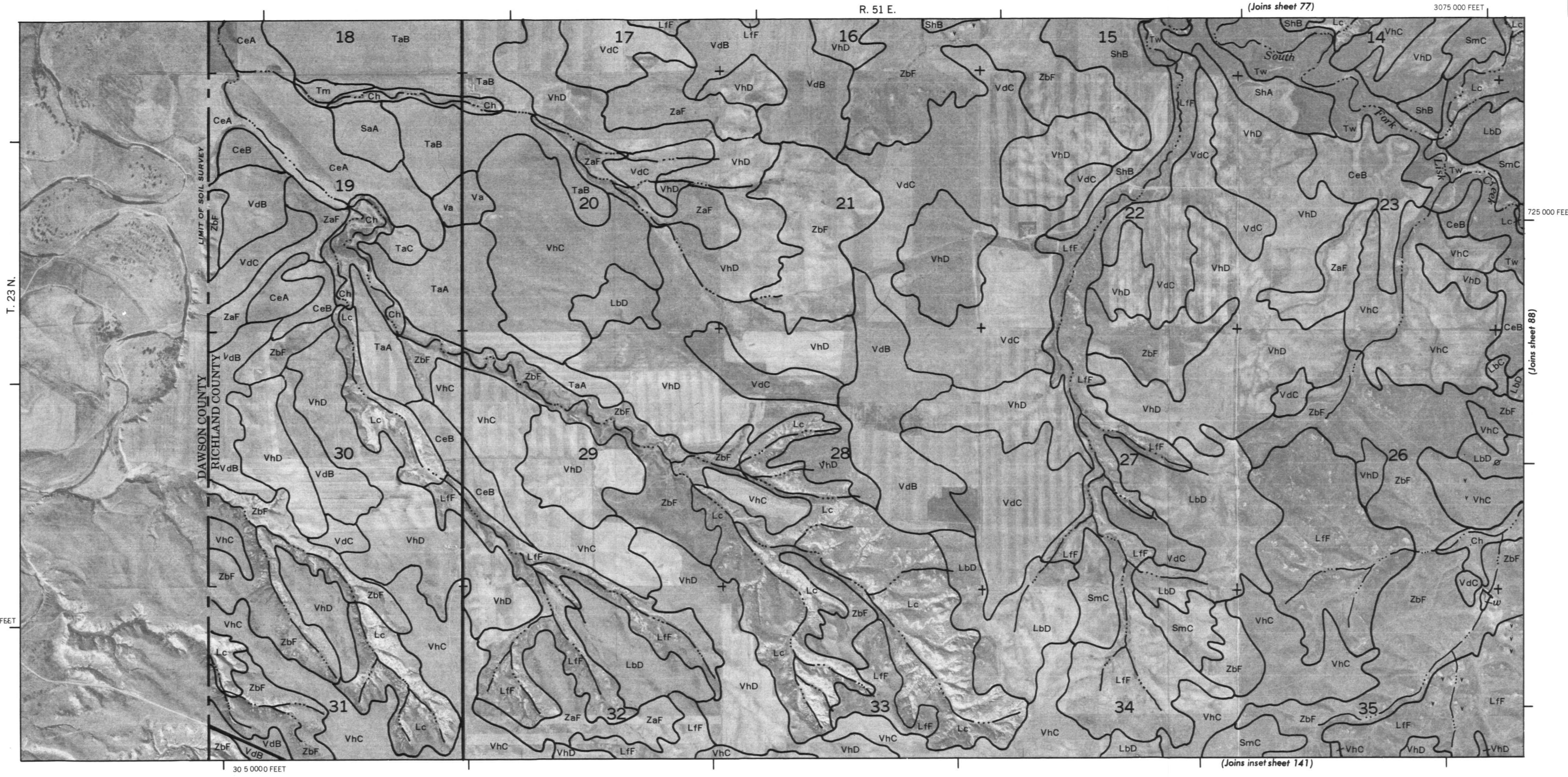
Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 86

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned



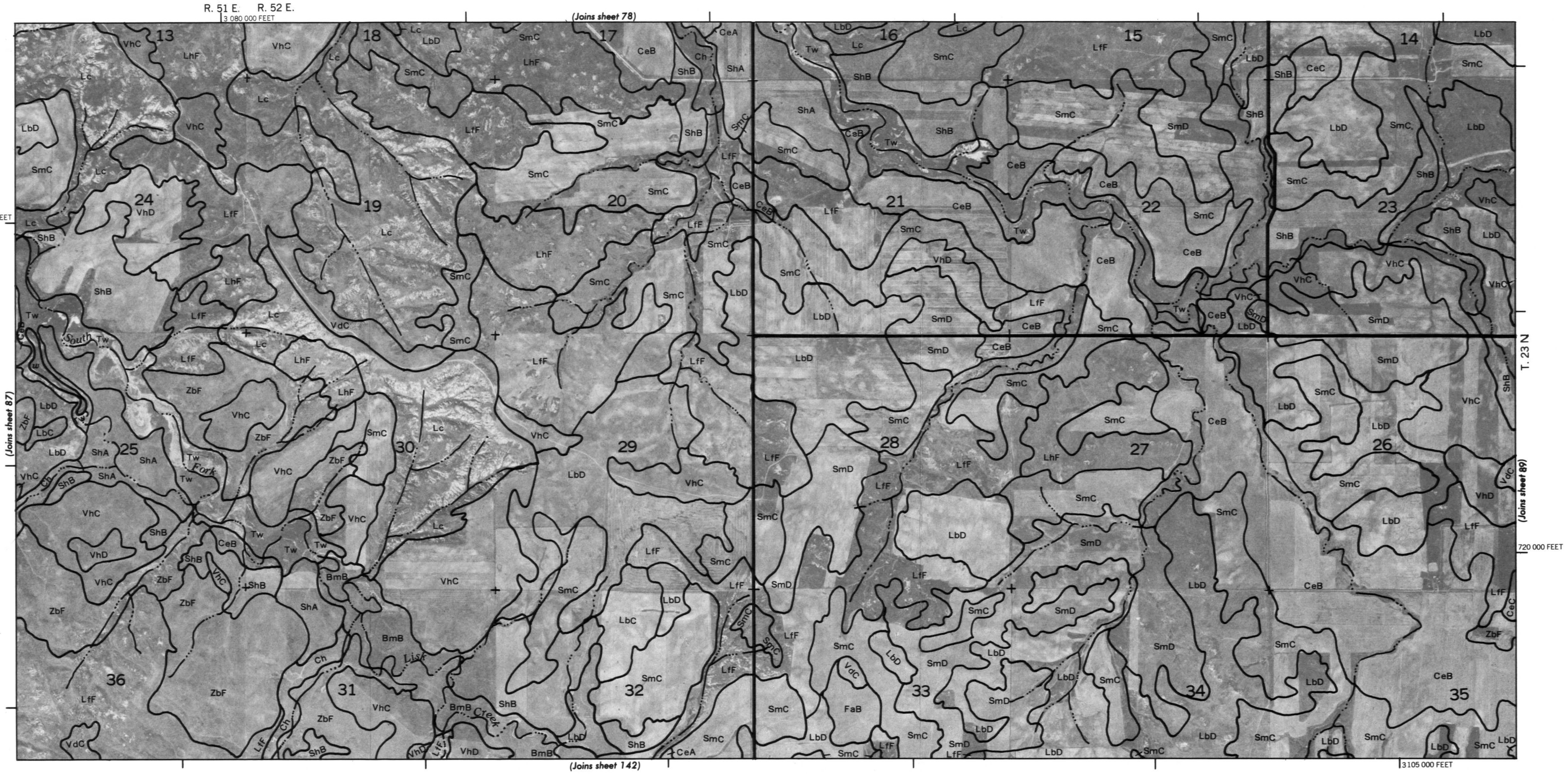
1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

RICHLAND COUNTY, MONTANA — SHEET NUMBER 88

N



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

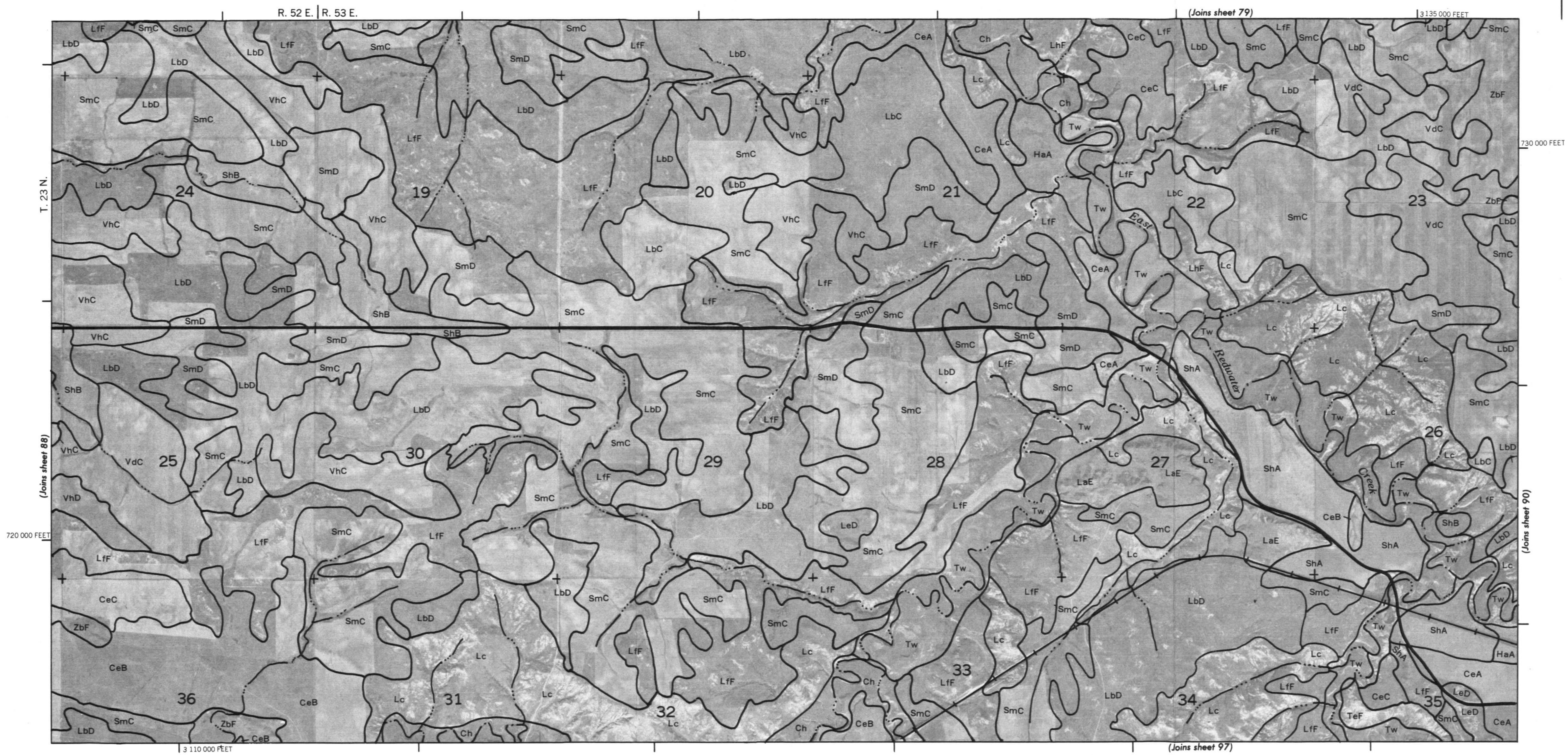
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

N

RICHLAND COUNTY, MONTANA NO. 89

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 10 000 Feet

Scale 1:24 000

RICHLAND COUNTY, MONTANA — SHEET NUMBER 90

N

Scale 1:24000

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

N

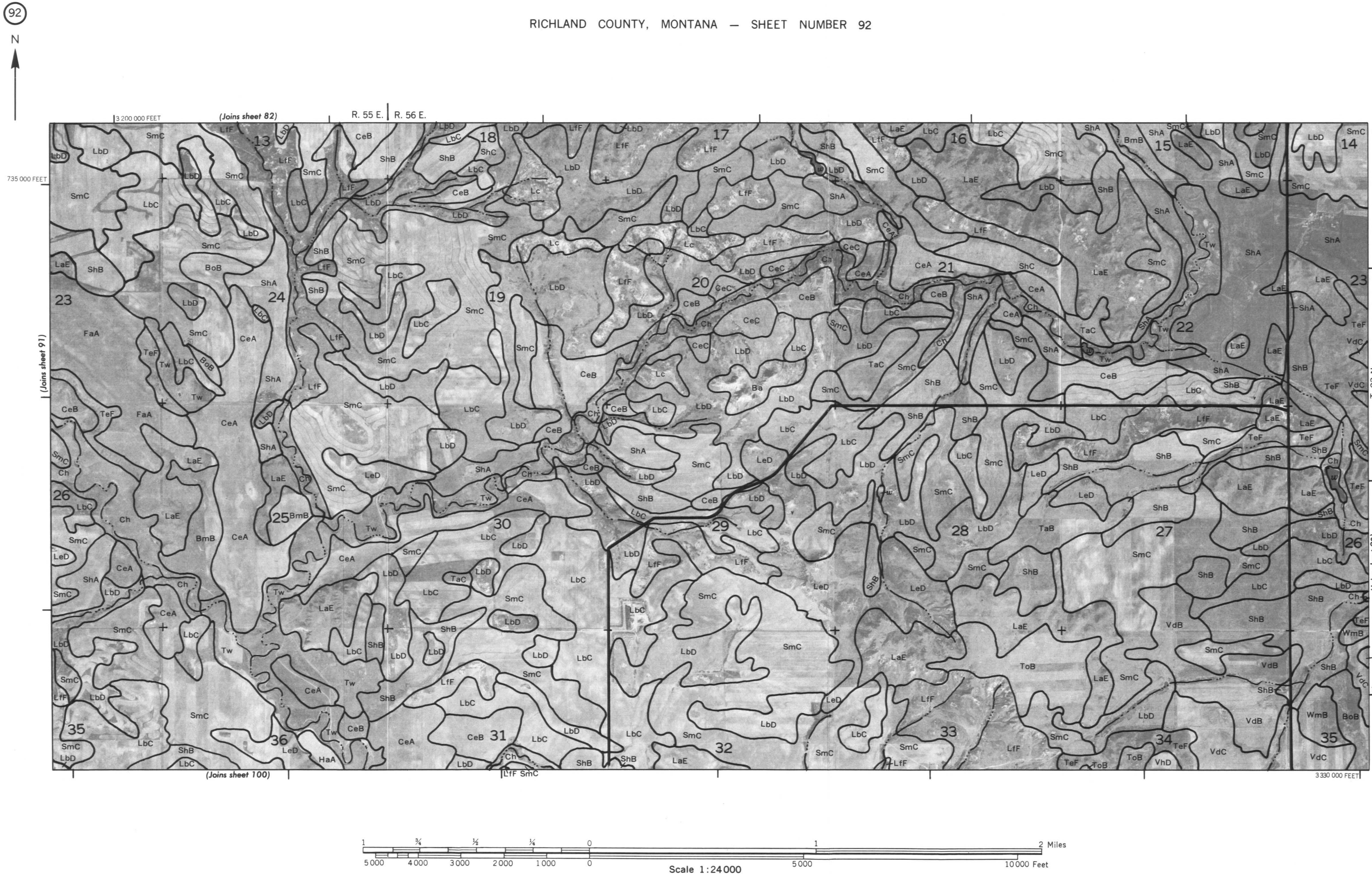
1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

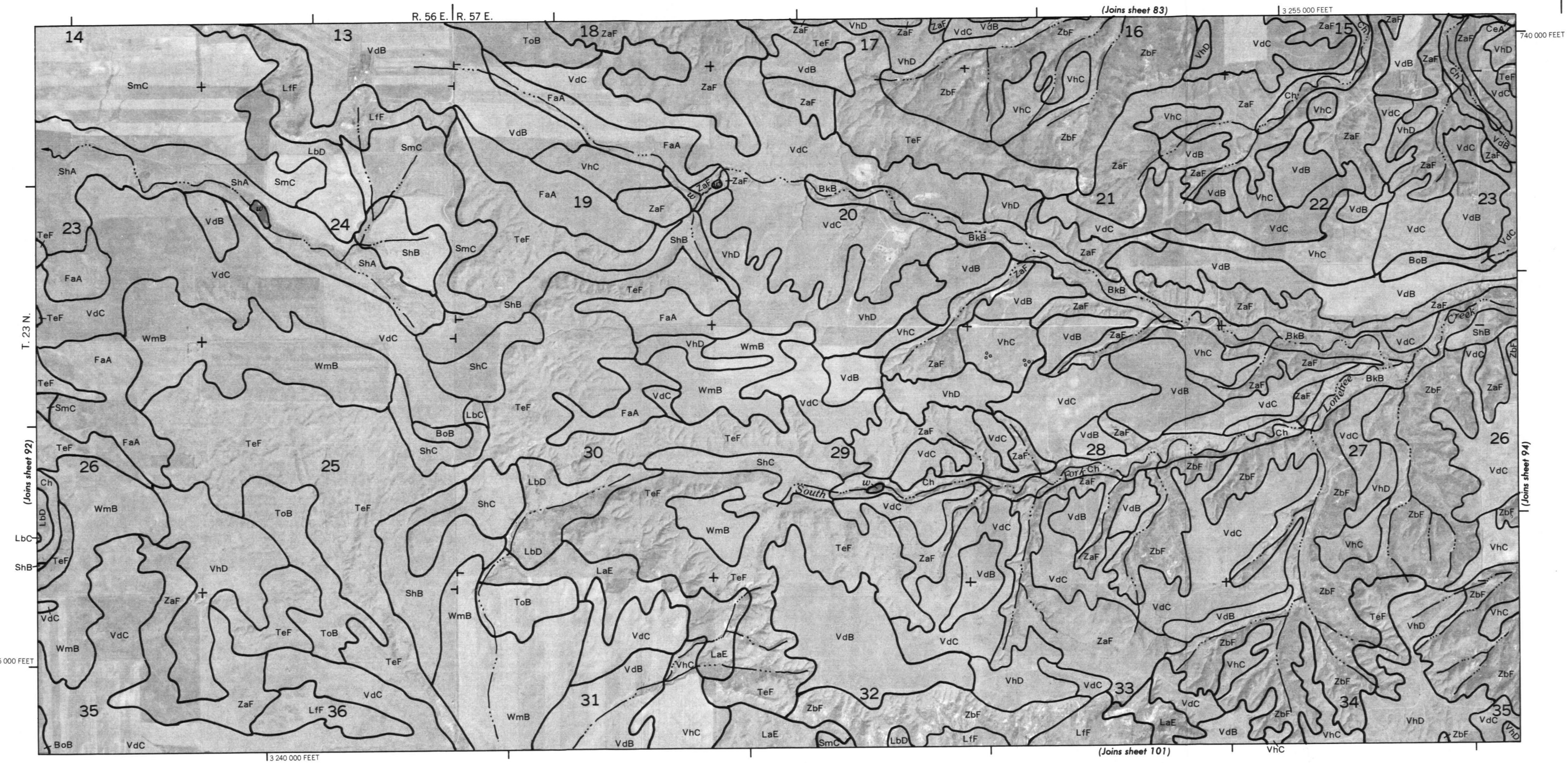
RICHLAND COUNTY, MONTANA — SHEET NUMBER 92



5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

N



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

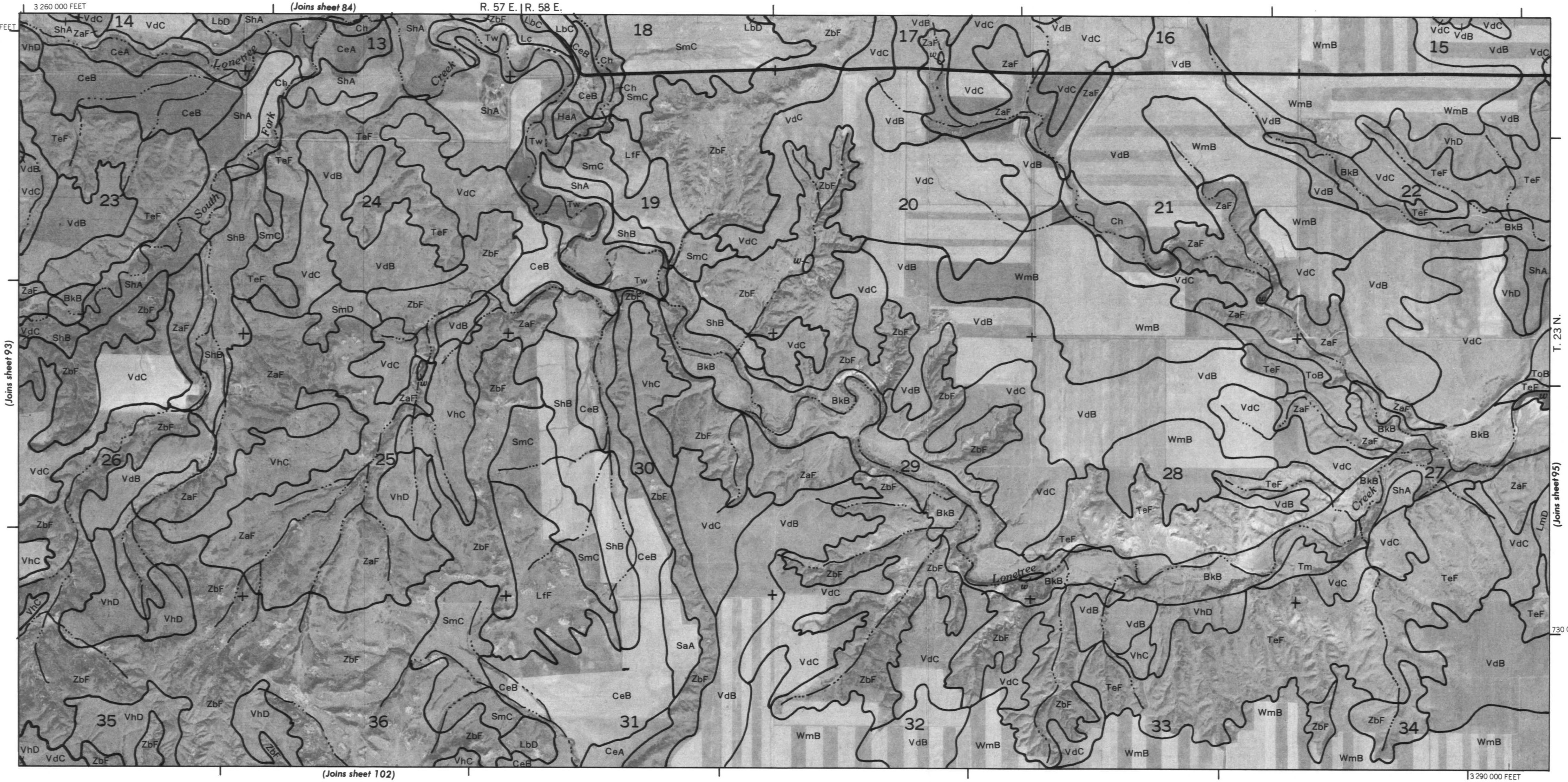
Scale 1:24000

RICHLAND COUNTY, MONTANA NO. 93

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

N

RICHLAND COUNTY, MONTANA — SHEET NUMBER 94



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

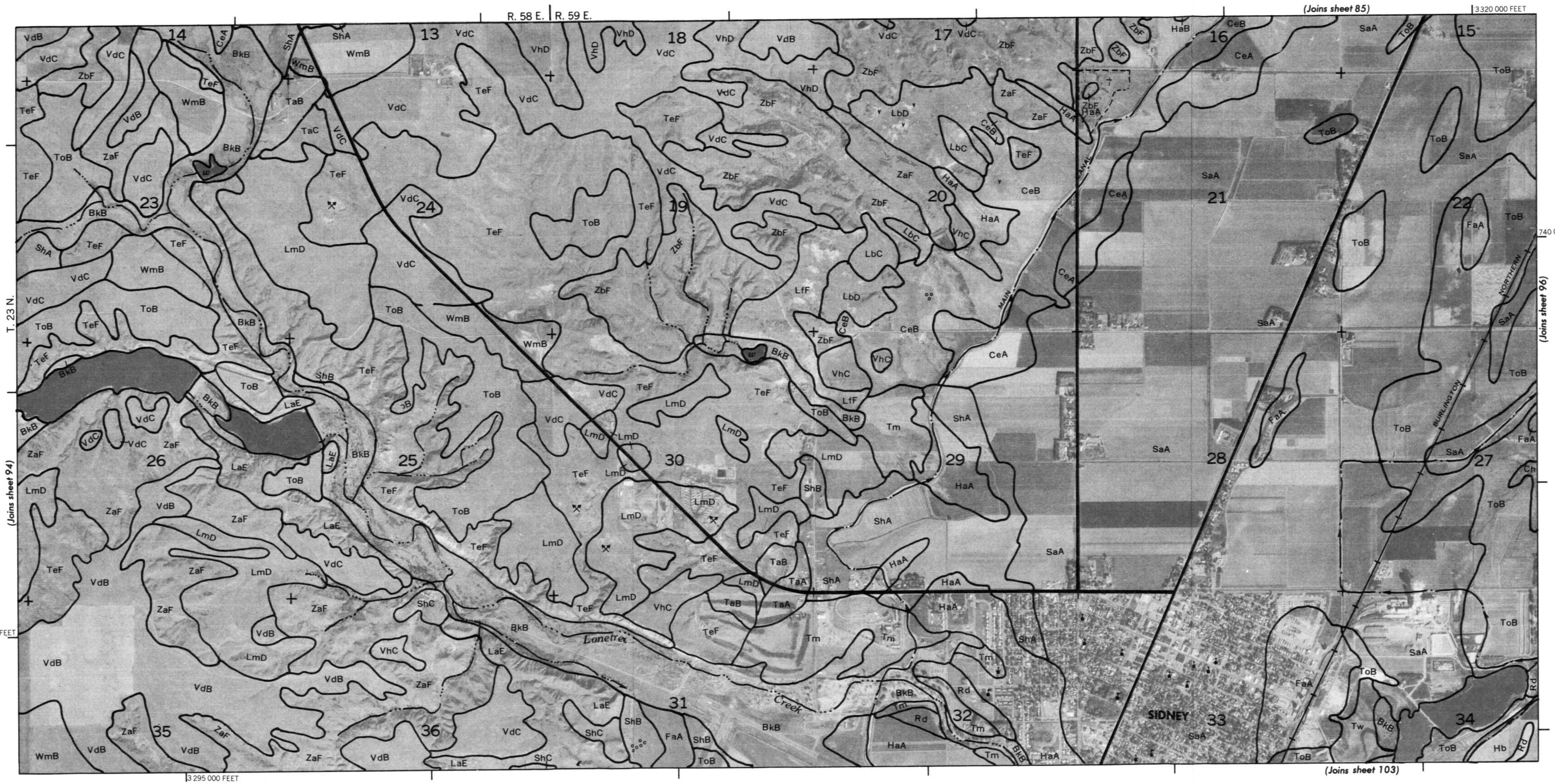
Scale 1:24000

5,000 foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 94

N



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. 5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

N

RICHLAND COUNTY, MONTANA — SHEET NUMBER 96

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

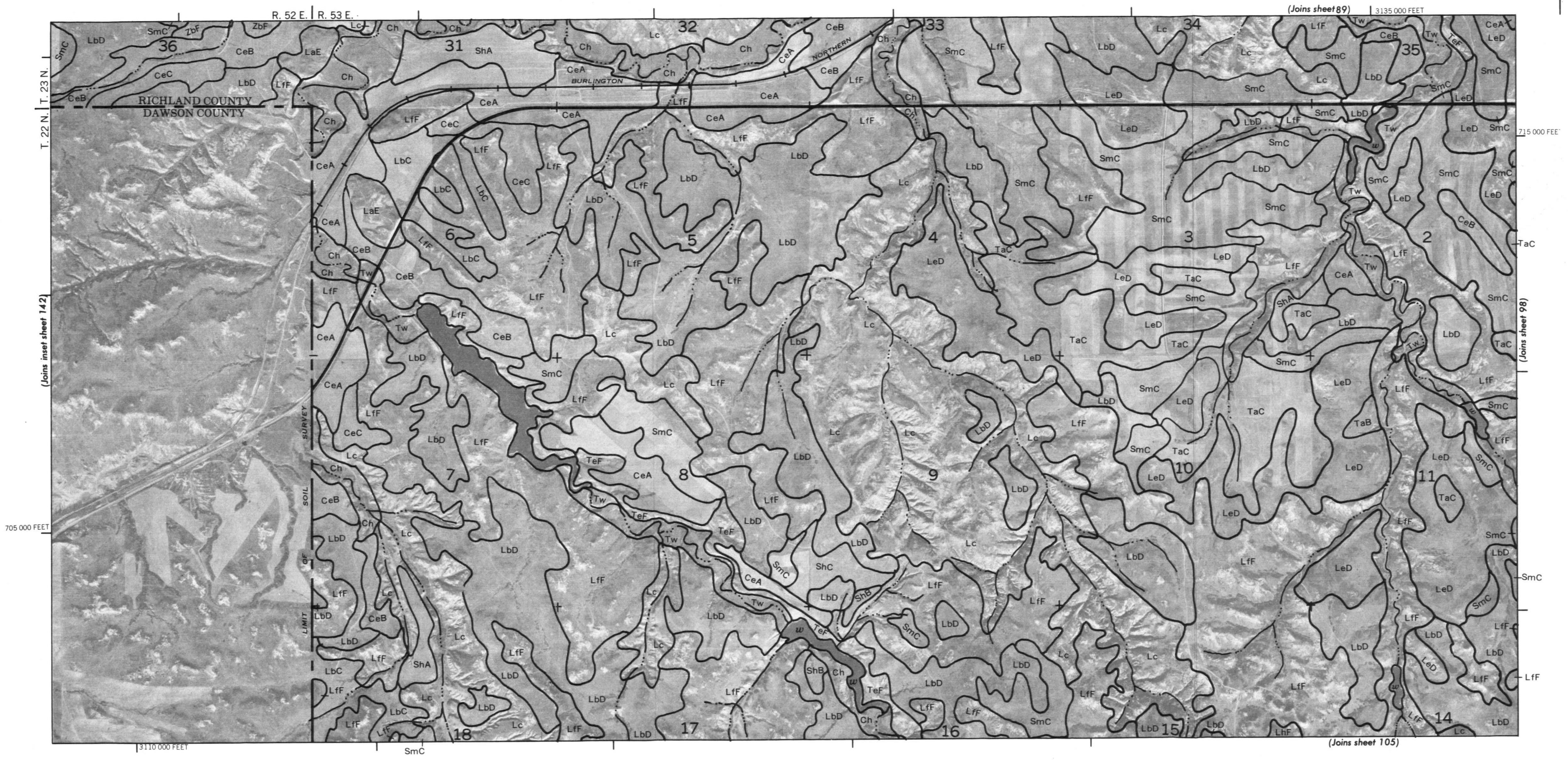
Scale 1:24000

5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

RICHLAND COUNTY, MONTANA NO. 97

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

RICHLAND COUNTY, MONTANA — SHEET NUMBER 98

1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000

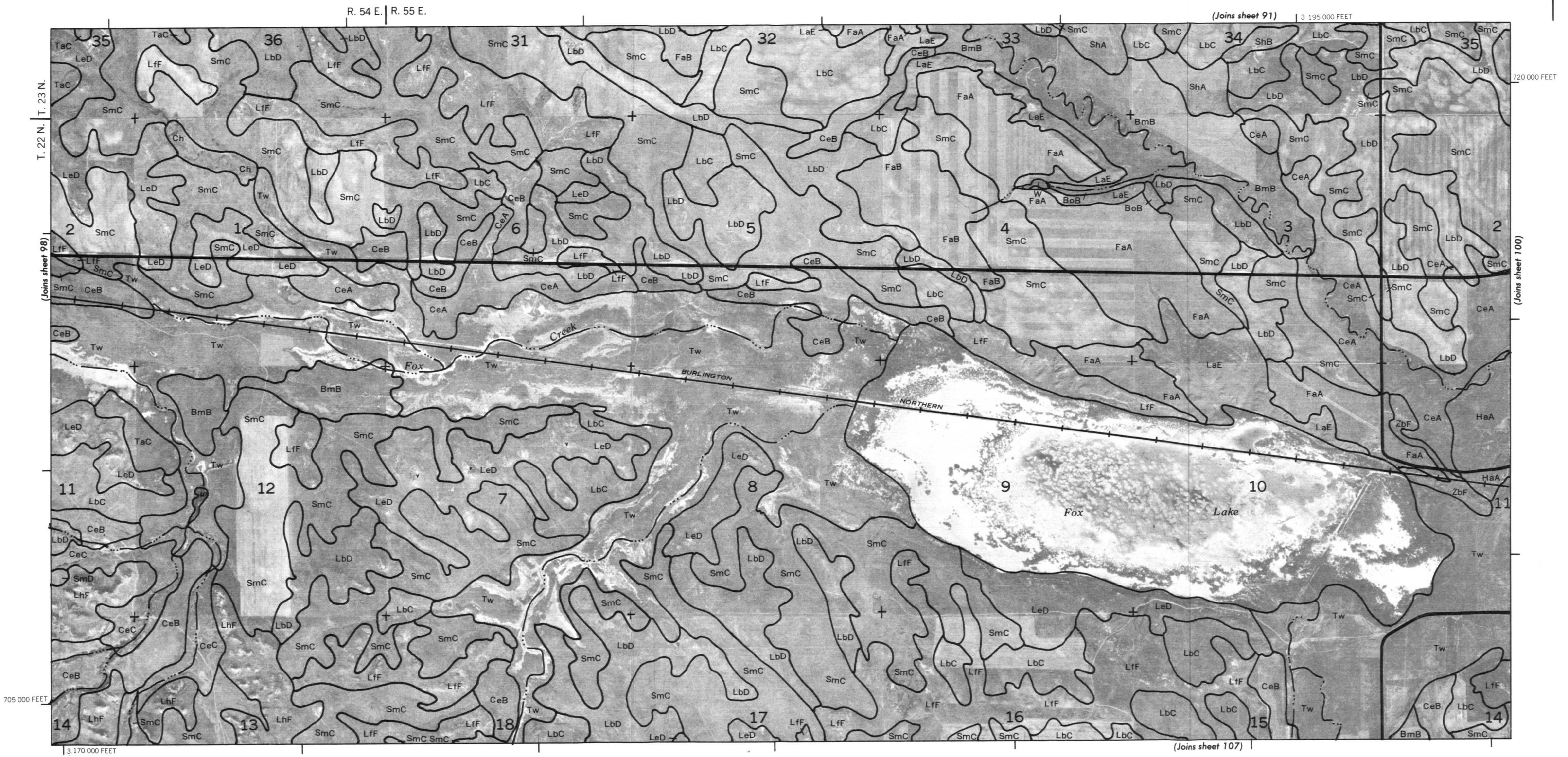
5 000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

N

RICHLAND COUNTY, MONTANA NO. 99

This map was compiled on 1975 U.S. Department of the Interior, Geological Survey orthophotography, by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



1 ¾ ½ ¼ 0 1 2 Miles

5000 4000 3000 2000 1000 0 5000 10000 Feet

Scale 1:24000